Dublin Airport North Runway Relevant Action Application

Environmental Impact Assessment Report
Volume 4 - Appendices

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Quality information

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Appendices

Acronyms and Abbreviations

Abbreviation / Term	Definition
%	Percentage
µg/m^3	Microgram per cubic meter
µm	Micro-metre. A measure of length equalling 1x10^{-6} of a metre
AA	Appropriate Assessment
ABP	An Bord Pleanála
ACA	Architectural Conservation Area
AEDT	Aviation Environmental Design Tool
ANCA	Aircraft Noise Competent Authority
ANPR	Automatic Number Plate Registration
ANQ	Annual Noise Quota
APU	Auxiliary Power Units
AQLV	Air Quality Limit Values
ATM	Air Traffic Movement
ASI	Archaeological Survey of Ireland
AQC	Air Quality Consultants
ACDM	Airport Collaborative Decision Making
BCT	Bat Conservation Trust
BNL	Basic Noise Level.
BSI	British Standards Institute
CAR	Commission for Aviation Regulation
CAFE	Cleaner Air for Europe
CCD	Climb, Cruise and Descent
CCR	Climate Change Resilience
CEMP	Construction Environmental Management Plan
CFRAM	Catchment Flood Risk Assessment and Management
CGI	Computer Generated Imagery
CHD	Coronary Heart Disease
CH_4	Methane
CIEEM	Chattered Institute of Ecology and Environmental Management
CIRIA	Construction Industry Research and Information Association
cNAO	Candidate Noise Abatement Objective
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CODA	Central Office of Delay Analysis
CO_2	Carbon Dioxide
COMAR	Control of Major Accident Hazard
CTPRO	Change to Permitted Runway Operations
CSO	Central Statistics Office
CD	Cardiovascular Disease

Abbreviation / Term	Definition
C_6H_6	Benzene
DAA	Dublin Airport Authority
dB	The unit of noise measurement that expresses the loudness in terms of decibels (dB) based on a weighting factor for humans sensitivity to sound (A)
dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies
DBA	Desk-Based Assessment
DCHG	Department of Culture, Heritage and the Gaeltacht
DCLG	Department od Communities and Local Government
DECC	Department of Energy and Climate Change
Defra	Department for Environment, Food and Rural Affairs
DfE	Department of Education
DfT	Department for Transport
DoEHLG	Department of Transport and the Department of Environment, Heritage and Local Government
DRAQMP	Dublin Regional Air Quality Management Plan
DTTAS	Department of Transport, Tourism and Sport
DUB	Dublin
EASA	European Aviation Safety Agency
EC	European Commission.
ED	Electoral Divisions
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EPS	European Protected Species
EPUK	Environmental Protection UK
ETS	Emission Trading Scheme
EU	European Union.
FAA	Federal Aviation Administration
FDI	Foreign Direct Investment
FEGP	Fixed Electrical Ground Power
FCC	Fingal County Council
FRA	Flood Risk Assessment.
NFTMS	Flight Track Monitoring System
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GLVIA	Guidelines for Landscape and Visual Impact Assessment
GSE	Ground Support Equipment
ha	Hectare
HFCs	Hydrofluorocarbons
HIA	Health Impact Assessment
HSA	Health and Safety Authority

Abbreviation / Term	Definition
HSE	Health and Safety Executive
HT	High Technology
IAA	Irish Aviation Authority
IAI	Institute of Archaeologists Ireland
IAQM	Institute of Air Quality Management
ICAO	International Civil Aviation Organisation
ICE	Inventory of Carbon and Energy
ICCI	In-combination climate change impact assessment
IEMA	Institute of Environmental Management and Assessment
IFC	International Finance Corporation
IFI	Inland Fisheries Ireland
IGI	Institute of Geologists of Ireland
IHD	Ischaemic Heart Disease
IHT	Institution of Highways and Transportation
IPC	Integrated Pollution Control
IPPC	Intergovernmental Panel on Climate Change
ISO	International Organisation for Standardisation
IW	Irish Water
JA	Jobseekers Allowance
JB	Jobseekers Benefit
km	Kilometres
LAP	Local Area Plan
LAQM	Local Air Quality Management.
LDC	Least Developed Countries
LLDC	Landlocked Developing Countries
Ltd.	Limited
LTO	Landing and Take-off
mppa	Million Passengers Per Anum
NAO	Noise Abatement Objective
NAP	National Aviation Policy
N/A	‘Not applicable’ or ‘Not appropriate’
NDP	The National Development Plan 2018 – 2027
NFTMS	Noise and Flight Track Monitoring System
NF_3	Nitrogen Trifluoride
NIAH	National Inventory of Architectural Heritage
NIS	Natura Impact Statement
NLS	National Landscape Strategy
NMS	National Monument Service
NMTs	Noise Monitoring Terminals
NO_2	Nitrogen Dioxide
NOEL	No Observed Effect Level
NO_x	Nitrogen Oxides

Abbreviation / Term	Definition
NPPF	National Planning Policy Framework (UK)
NPF	National Planning Framework
NPPG	National Planning Policy Guidance (UK)
NPWS	National Parks and Wildlife Services
NQP	Night Quota Period
NRA	National Roads Authority
NSO	National Strategic Outcomes
NSS	National Spatial Strategy
NTA	National Transport Authority
NTS	Non-Technical Summary
N_2O	Nitrous Oxide
O-D	Origin-Destination
OPW	Office of Public Works
OS	Ordnance Survey
OSI	Ordnance Survey Ireland
PAX	Annual Passengers
PDA	Planning and Development Acts
PFCs	Perfluorocarbons
PM_{10}	Particulate Matter
$PM_{2.5}$	Particulate Matter
PWHT	Polluted Water Holding Tank
QC	Quota Count
QI	Qualifying Interest
RMP	Record of Monument and Places
RMSE	Root Mean Square Error
RoI	Republic of Ireland
RPS	Record of Protected Structures
RSES	Regional Spatial and Economic Strategy
PSZ	Public Safety Zones
SA	Small Areas
SAC	Special Area of Conservation
SCI	Special Conservation Interests
SEAI	Sustainable Energy Authority of Ireland
SF_6	Sulphur Hexafluoride
SI	Statutory Instrument
SID	Standard Instrument Departure
SIDS	Small Island Developing States
SO_2	Sulphur Dioxide
SPA	Special Protected Area
SRI	Societal Risk Index
SSSI	Site of Special Scientific Interest
TFS	Trans frontier Shipping

Abbreviation / Term	Definition
TII	Transport Infrastructure Ireland
TOC	Total Organic Carbon
TPA	Tom Philips + Associates
TTA	Traffic and Transport Assessment
UK	United Kingdom
UV	Ultraviolet
VOC	Volatile Organic Compounds
WFD	Water Framework Directive
WHO	World Health Organisation
ZOI	Zone of Influence

Key Concepts and Terminology Used in the EIAR

(Proposed) Relevant Action
The proposed **Relevant Action** is to amend condition no. 3(d) and replace condition 5 of the **North Runway Planning Permission**, as described in Chapter 1 ('Introduction') and Chapter 2 ('Characteristics of the Project').

32 million passengers per annum (mppa) Cap (32 mppa Cap)
Cap on the permitted annual passenger capacity of the Terminals at Dublin Airport as a result condition no. 3 of the **Terminal 2 Planning Permission** and condition no. 2 of the **Terminal 1 Extension Planning Permission**. These conditions provide that the combined capacity of Terminal 1 and Terminal 2 together shall not exceed 32 million passengers per annum.

Permitted Scenario
This scenario assumes that the North Runway becomes operational but the airport is constrained by the restrictions on night-time use of the runway system at Dublin Airport, namely the restriction on the number of flights permitted between the hours of 23:00 and 07:00 which limits the number of flights to an average of 65 between these hours and the restriction of the use of North Runway at night (no use between 23:00 and 07:00) (i.e. conditions no. 3(d) and no. 5). These conditions do not currently apply to Dublin Airport but would come into force once the North Runway becomes operational. The **Permitted Scenario** also assumes that the current **32 mppa Cap** remains in place. Taken together, these characteristics mean that the **Permitted Scenario** represents the 'do nothing' case.

Proposed Scenario
This scenario represents the situation with the proposed **Relevant Action** in place. It assumes that the North Runway becomes operational but the airport is not constrained by the restrictions on night-time use of the runway system at Dublin Airport, namely the restriction on the number of flights permitted between the hours of 23:00 and 07:00 which limits the number of flights to an average of 65 between these hours (i.e. conditions no. 3(d) and no. 5). Instead the **Proposed Scenario** involves use of North Runway in the shoulder hours 06:00 to 07:00 and 23:00 to 00:00 and the introduction of a noise **Quota Count System** to replace the 65 average number of flights restriction. The **Proposed Scenario** also assumes that the current **32 mppa Cap** remains in place.

Current State of the Environment
The is the description of the current environmental conditions, as required by the EIA Directive 2011/92/EU (as amended by Directive 2014/52/EU). It is determined through desk-study and surveys undertaken between 2018 and 2021, as detailed in the technical chapters.

Future Receiving Environment
The **Future Receiving Environment** is the predicted state of the environment in three **Assessment Years** (2022, 2025 and 2035) and represents the likely evolution of the **Current State of the Environment** without implementation of the proposed **Relevant Action**. It is also used as the baseline environment against which the assessment of effects of the **Proposed Scenario** is undertaken. It is derived from the **Current State of the Environment**, adjusted to reflect likely changes occurring between now and the assessment years (insofar as it is possible to determine these).
This is in line with the draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports (EPA, 2017) which explain that the predicted future baseline may be referred to as the likely future receiving environment.

Assessment of Effects
The effects of the proposed **Relevant Action** are identified by examining the predicted impacts of the **Permitted Scenario** on the **Future Receiving Environment** and comparing these with the predicted impacts of the **Proposed Scenario** on the same **Future Receiving Environment**.

Assessment Year(s)
The **Assessment Years** are the points in time at which the likely significant effects of the proposed **Relevant Action** are assessed. The reasons for selecting these years are given below.

- **2022**: the year when the North Runway is first expected to become operational.

- **2025**: the first year of highest use of the runway system in the **Proposed Scenario** (i.e. when 32 million passengers per annum throughput is first expected to be reached but not exceeded). This is also the first year of predicted maximum environmental effects in the **Proposed Scenario**.

- **2035**: this year has been included in the assessment in response to a request from Fingal County Council for Further Information which sought assessment of a longer-term scenario (i.e. 10 or 15 years post opening year scenario (2022).

North Runway Planning Permission

The **North Runway Planning Permission** is the planning application FCC Reg. Ref. No. F04A/1755; ABP Ref. No.: PL06F.217429 granted on 29th August 2007, and as amended by FCC F19A/0023, ABP Ref. No. ABP-305298-19 granted on the 18th March 2020 by An Bord Pleanála.

Terminal 1 Extension Planning Permission

The **Terminal 1 Extension Planning Permission** is the planning application FCC Reg. Ref. No. F06A/1843, ABP Ref. PL06F. 223469 granted on the 10th January 2008 by An Bord Pleanála.

Terminal 2 Planning Permission

The **Terminal 2 Planning Permission** is the planning application FCC Reg. Ref. No. F06A/1248, ABP Ref. PL06F.220670 granted on the 29th August 2007 by An Bord Pleanála.

Balanced Approach

The principle of the "balanced approach" to aircraft noise management was adopted by the International Civil Aviation Organisation (ICAO) Assembly in 2011. The **Balanced Approach** recognises the importance of achieving a careful balance between the interests of developing airport growth as well as managing noise levels; operating restrictions are only considered when all other elements of the **Balanced Approach** have been assessed.

Noise Abatement Objective

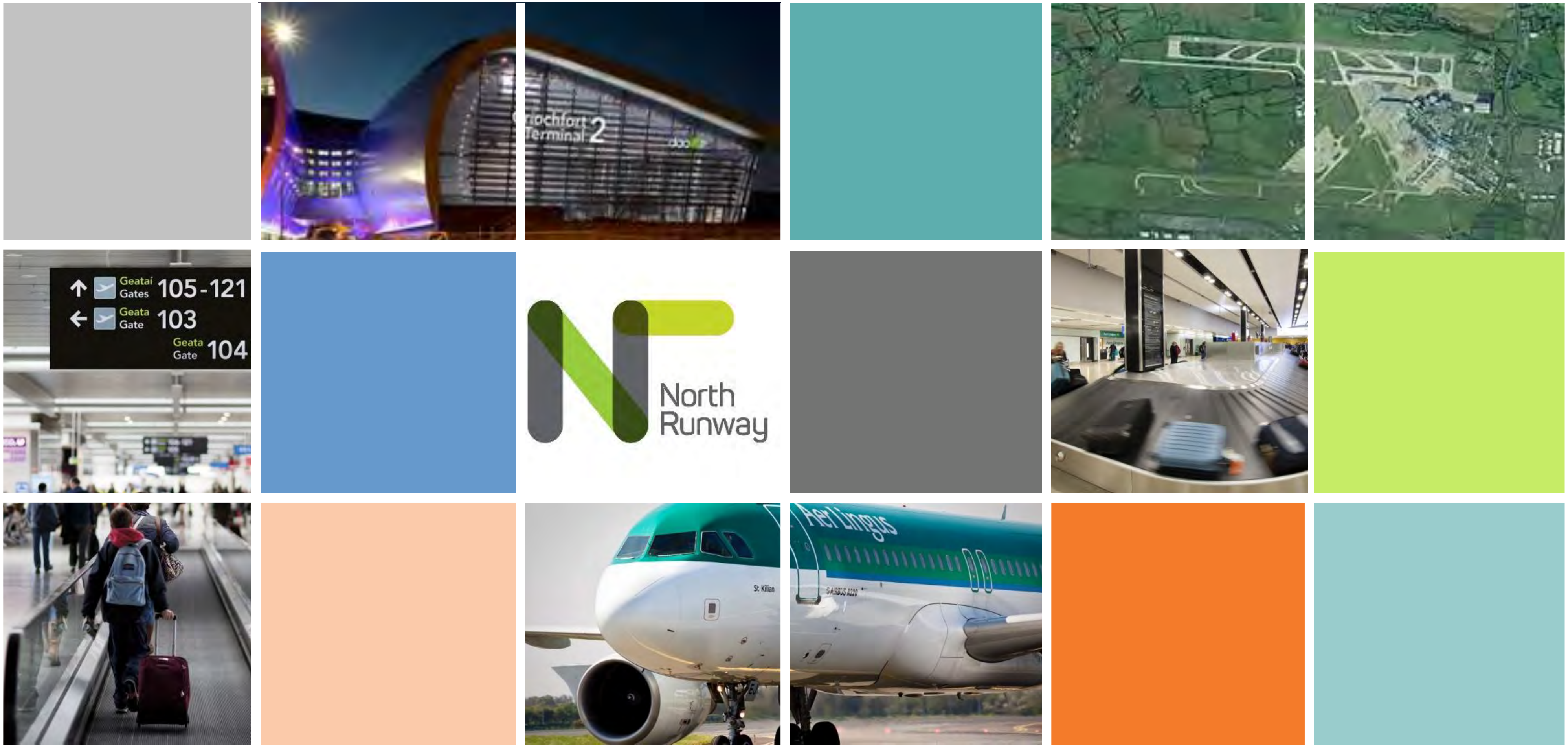
The Aircraft Noise (Dublin Airport) Regulation Act 2019 (Aircraft Noise Act) implements European Union Regulation 598/2014 on the establishment of rules and procedures with regard to the introduction of noise related operating restrictions at EU Airports within the **Balanced Approach**.
The Aircraft Noise Act also sets out a process of aircraft noise regulation whereby the Aircraft Noise Competent Authority (ANCA) shall ensure that the **Balanced Approach** is adopted where a noise problem at the airport has been identified and requires the identification of a **Noise Abatement Objective** (NAO) as appropriate.

Quota Count System

A Quota Count (QC) system is designed to limit the overall amount of noise produced by aircraft using an airport, based on an allowable Annual Noise Quota (ANQ) for a given time period. A QC value is assigned to each individual aircraft movement based on the certified noise level of that aircraft. Lower QC values are attributed to aircraft with lower noise levels, higher values to noisier aircraft. The QC accumulates for each Air Traffic Movement (ATM) against the allowable ANQ across the chosen time period. As such, the system allows a greater number of quieter aircraft movements within a given quota thereby encouraging the use of quieter aircraft at the airport.

Appendix 1A. Operating Restrictions Report

Document Classification: Class 1 - General



Dublin Airport Operating Restrictions

Quantification of Impacts on Future Growth

Updated analysis in response to the ANCA RFI

daa

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June 2021 - version 1.3.1 (Final)

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Revision	Date	Originator	Checker	Approver
1.0	24/05/2021	JC	NR	JR
1.1	28/05/2021	JC	NR	JR
1.2	03/06/2021	JC	NR	JR
1.3	24/06/2021	JC	NR	JR
1.3.1	30/06/2021	JC	NR	JR

Contents

Executive summary

Introduction

- daa is developing a new North Runway with operations planned for 2022. The runway's planning permission granted in 2007 contains 31 conditions. Condition 3d requires that that the new North Runway will not be used between the hours of 23:00-07:00 local time, and Condition 5 limits the number of 23:00-07:00 operations to 65/night on average when the new runway is in operation.
- The airport is also subject to a planning condition related to the development of Terminal 2 (which opened in 2010) which caps DUB's annual terminal passenger throughput at 32 million.
- From March 2020, the global aviation industry has been impacted by the COVID-19 pandemic and associated air travel restrictions, leading to large reductions in airport throughput in 2020, with only partial recovery expected in 2021.
- This updated assesses the impact of the proposed North Runway operating restrictions during the period from 2022 until the airport's unconstrained demand returns to the 32 million annual passenger level, expected in 2025.
- Longer term forecast scenarios (unconstrained and constrained) are also presented for the period from 2025 to 2040.

Demand

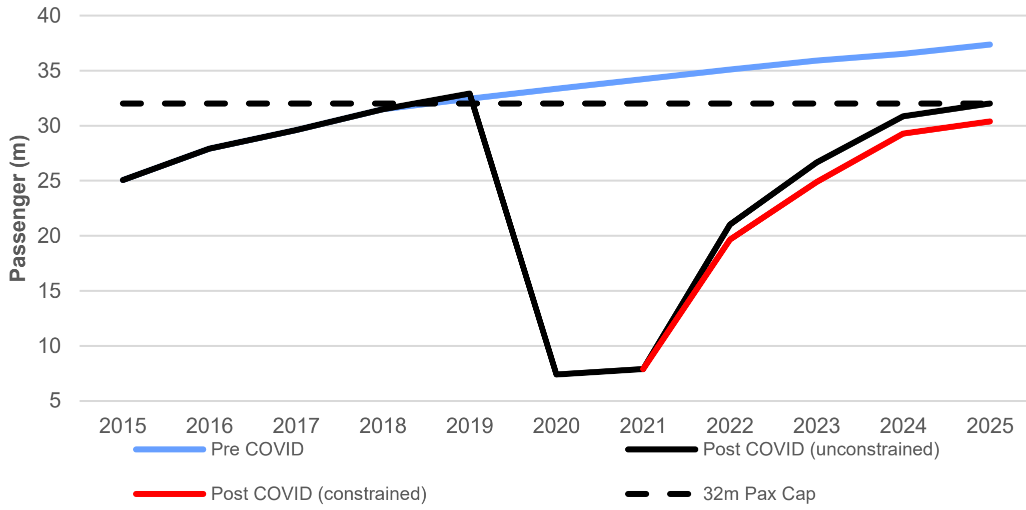
- Dublin Airport (DUB) saw strong traffic growth during the 2009-2019 period to a peak of 32.9m passengers in 2019. Ireland's island status means that air connectivity is critical to its economic development.
- The airport has two main airlines providing the majority of flights: Ryanair (35% share) and Aer Lingus (29% share), based on the Summer 2019 schedule. The airport serves mostly short haul services (90% of flights) to points in the UK and Europe. Long haul services are mainly to North America, plus some services to the Middle East, Asia and Africa.
- Demand for night flights between 23:00-07:00 is driven mainly by short haul services operated by aircraft based at DUB. In order to achieve the high levels of aircraft utilisation necessary for airline competitiveness, based aircraft tend to operate with first departure between 06:00-07:00 and last arrival after 23:00. Other 23:00-07:00 period flights are long haul arrivals in the early morning, and a small number of cargo flights mainly operated by the time-critical package delivery integrators (FedEx, DHL, TNT and UPS).
- The 1h time difference between Ireland and mainland Europe means that flights need to leave early (before 07:00) to arrive in time for business passengers to have a full working day at their destination. The geographical position of DUB means that there are longer sector distances to many European destinations than from other competing airports. This means that DUB requires longer operating days than competing European hubs. Similarly, DUB's proximity to North America compared to the rest of Europe means that transatlantic flights arrive earlier in DUB than at other European airports.
- The duration of the proposed DUB night time restrictions period, spanning 8h from 23:00 to 07:00, is unusually broad compared to other airports with such restrictions. The average night restrictions periods are 6h to 6.5h in duration. For example, the London airports night restrictions period is 23:30 to 06:00 local time.
- The DUB night restrictions period is also unusual in that it includes a peak hour of demand at the airport – 06:00-07:00. Therefore, the impact of the restriction on future growth is very significant.
- Pre-COVID levels of demand for night flights (23:00-07:00) is over 100/night, with 113/night associated with regularly scheduled services on a typical busy day in Summer 2019. This is far in excess of the proposed limit of 65/night (measured as an average over the 92 day modelling period).
- Demand for 23:00-07:00 night flights is not expected to reduce significantly during the post COVID recovery. As traffic recovers to pre-COVID levels by 2025, the forecast schedules analysed for this study require 116/night movements for regularly scheduled services (excluding ad hoc flights).
- The need for night flights at DUB – driven by the need for airlines to achieve competitive levels of aircraft utilisation, flight connection connectivity, and to support timely air freight services into Ireland – is not diminished for the post COVID air transport scenario.

Executive summary

Impact of Operating Restrictions

- The chart opposite shows the post COVID recovery scenario (unconstrained) compared with the daa's pre COVID centreline forecast scenario. After the severe disruption to air travel in 2020 and partial recovery in 2021, demand is forecast to recover to 64% of 2019 levels by 2022 and grow to 32m annual passengers by 2025.
- This study simulated the slot coordination process to create constrained busy day schedules from 2022 (representing the first year of operations of the new runway) to 2025 (when the 32m passenger level is expected to be reached).
- It modelled the impact of the North Runway night operating restrictions (Conditions 3d and 5) and overall runway capacity (operating in compliance with the planning conditions) on airline schedules, taking into account the impacts on aircraft rotations throughout the day.
- The assessed impact of the night operating restrictions is a loss of 6.3m passengers (-5.7%) over the 4-year period 2022-2025. It should be noted that this estimated impact assumes that airlines are willing and able to accept alternative slot times outside of the 23:00-07:00 night period, which would be commercially and/or operationally suboptimal. In a post-COVID crisis environment, weak passenger demand is likely to mean that airline flexibility may be reduced, and the actual impact of the operating restrictions could be higher.
- The burden of the night restrictions falls mainly on the DUB-based Irish carriers Aer Lingus and Ryanair. The DUB-based carriers require early morning departures and late evening arrivals for their short haul operations, and Aer Lingus requires early morning arrivals for its transatlantic operations. Non-Irish carriers are less affected by the restrictions as they have proportionately fewer operations in the restricted 23:00-07:00 period.
- The operating restrictions constrain growth in short haul operations throughout the day, as the lack of night slots limits the number of DUB-based aircraft that can be accommodated, with each aircraft performing multiple flights during the operating day.
- Condition 3d (limiting night operations to a single runway) does not in itself act as an additional constraint, as it provides sufficient capacity for a 65/night limited schedule. However, in the absence of the Condition 5 night movement limit, there is a requirement for dual runway operations between 06:00-07:00 to meet demand.

DUB Annual Passenger Forecasts Unconstrained v Constrained



Annual Traffic Impact Summary (millions of passengers)

	2022	2023	2024	2025	2022-2025 Total
Unconstrained	21.0	26.7	30.8	32.0	110.5
Constrained	19.6	24.9	29.3	30.4	104.2
Difference	-1.4	-1.8	-1.6	-1.6	-6.3

Source: Mott MacDonald analysis

Note:
***Unconstrained** is Scenario D – without Conditions 3d and 5 in place and with 32m annual passenger cap **(Proposed scenario)**; **Constrained** is Scenario E – with Condition 3d and 5 in place and the 32m annual passenger cap **(Permitted scenario)**, as referred to in the planning application and Environmental Impact Assessment Report (EIAR)*

Annual Traffic Impact

Impact of Operating Restriction Scenarios

- This study has developed busy day forecast schedules and analysed the impacts of operating restrictions for four scenarios, in addition to the original daa input schedule, as summarised in the tables opposite.
  - **Scenario A** is the daa input busy day forecast schedules, aligned with the Centreline annual forecast case. Flights are timed at commercially and operationally 'ideal' timings and are not smoothed to fit within airport capacities
  - **Scenario B** applies the current North Runway night operating restrictions (the 65/night limit and no use of the North Runway 23:00-07:00), but does not apply the 32m annual passenger cap

    The night restrictions severely limit traffic growth, delaying post-Covid recovery to 2019 traffic levels by around 2 years (from 2025 to 2027).
  - **Scenario C** is an unconstrained schedule with no night limits or annual passenger cap. The daa input schedule (Scenario A) has been coordinated within the physical runway capacity constraints, adjusting flight times to smooth demand, but Scenario C has the same volume of flights as the daa input schedule. The runways are assumed to operate in mode Option 7b (see page 8) and according to the capacities discussed in Section 3 (page 20) of this report.

    Runway capacity is sufficient to accommodate the full daa input forecast schedule with relatively minor schedule timing adjustments. Unconstrained annual forecast passengers can be accommodated
  - **Scenario D** applies the 32m annual passenger cap to the runway capacity coordinated schedules of Scenario C, but does not apply the night operating restrictions (Conditions 3d and 5)

    The 32m passenger level is reached in 2025. The 32m cap begins to have an impact from 2024 as traffic growth approaches the 32m capped level asymptotically
  - **Scenario E** applies the 32m annual passenger cap to the night operating constrained schedule of Scenario B.

    The 32m passenger level is reached around 2027
  - **Scenario F** applies the restriction to operate one runway only 23:00-07:00, but without the 65/night movement cap and without the 32m annual passenger cap.

    Constrained runway capacity in the 06:00-07:00 hour for first-wave departures limits growth in DUB-based aircraft flying

Scenario	Condition 3d (single runway)	Condition 5 (night limits)	32m cap	Description
A	na	None	No	*daa input schedule*
B	2300-0700	65/night	No	*Night limit constraints*
C	2300-0600	None	No	*Unconstrained (runway capacity only)*
D	2300-0600	None	Yes	*32m cap only*
E	2300-0700	65/night	Yes	*Night limits + 32m cap*
F	2300-0700	None	No	*Single runway 2300-0700 only*

Scenarios	A	B	C	D	E	F
2015	25.0					
2016	27.9					
2017	29.6					
2018	31.5					
2019	32.9	32.9	32.9	32.9	32.9	32.9
2020	7.4	7.4	7.4	7.4	7.4	7.4
2021	7.9	7.9	7.9	7.9	7.9	7.9
2022	21.0	19.6	21.0	21.0	19.6	20.6
2023	26.7	24.9	26.7	26.7	24.9	26.2
2024	31.2	29.3	31.2	30.8	29.3	30.8
2025	32.3	30.4	32.3	32	30.4	31.9
2026	34.0	31.6	34.0	32	31.2	33.3
2027	35.6	32.8	35.6	32	32	34.7
2028	37.0	33.9	37.0	32	32	36.2
2029	38.4	35.1	38.4	32	32	37.6
2030	39.6	36.3	39.6	32	32	39.0
2031	40.5	37.0	40.5	32	32	39.7
2032	41.3	37.6	41.3	32	32	40.4
2033	42.1	38.2	42.1	32	32	41.0
2034	42.7	38.9	42.7	32	32	41.7
2035	43.4	39.5	43.4	32	32	42.4
2036	44.0	40.0	44.0	32	32	43.0
2037	44.7	40.5	44.7	32	32	43.6
2038	45.3	41.0	45.3	32	32	44.2
2039	46.0	41.5	46.0	32	32	44.7
2040	46.6	42.0	46.6	32	32	45.3
Traffic Impact						
2022-2025	-	-7.0	0.0	-0.7	-7.0	-1.7

Source: Mott MacDonald analysis, based on daa Centreline *forecast scenario*

Introduction

Introduction

Introduction

- This report quantifies the expected impacts of runway operating restrictions after the opening of the North Runway on traffic growth at Dublin Airport (DUB) during the period from 2022-2025 and in the long term to 2040.
- Dublin Airport traffic is forecast to return to 2019 (pre COVID) levels of around 32m passengers by 2025, and to grow to just over 46m passengers by 2040, based on unconstrained demand projections.
- The study assesses unconstrained patterns of demand and various capacity constrained scenarios reflecting different assumptions related to the North Runway planning conditions. These scenarios are described in Sections 3 and 5.

North Runway Planning Conditions

- daa is investing around €320 million to develop a new 3,110m runway for Dublin Airport, located 1.7km north and parallel to the existing main runway. The new runway is expected to be operational in 2022.
- The planning permission granted in 2007 contains 31 conditions. Two of these conditions (Conditions 3d and 5) relate to operating restrictions on the use of the runways and overall airport operations at night.
  - Limiting 23:00-07:00 night movements to 65/night
  - Restricting use of the new North Runway to daytime hours 07:00-23:00

Terminal 2 Planning Condition

- Dublin Airport is also subject to a planning condition linked to the development of Terminal 2 (which opened in 2010), which limits the annual number of passengers using the airport's terminals to 32 million.

New North Runway Layout

Source: daa

Introduction

Runway Planning Conditions

- The North Runway planning permission[1] contains the following conditions to take effect from completion of the new runway:
  - Condition 3(d) states that: *Runway 10L-28R shall not be used for take-off or landing between 2300 hours and 0700 hours*[2].
  - Condition 5 states that: *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.*

- This study interprets Condition 5 as follows:
  - Night movements are based on actual aircraft landing or taking-off times.
  - The 65/night limit is based on the average over the 92 day modelling period (16 June to 15 September).
  - All night operations, including ad hoc operations and unplanned operations (e.g., delayed daytime flights), as well as regularly scheduled night flights are taken into account.
  - Therefore, scheduling limits to ensure compliance must take account of aircraft taxi times and make reasonable allowances for delayed flights.

Runway Modes of Operation

Source: daa

(1) An Bord Pleanála decision 2007, Reference Number: PL06F.217429

(2) 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

Introduction

Irish National Aviation Policy

- The Department of Transport, Tourism and Sport published a National Aviation Policy (NAP) for Ireland in August 2015. The goals of the NAP 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.
- The NAP identified the opportunity to develop Dublin Airport as a secondary hub, competing effectively with the UK and other European airports for the expanding global aviation services market. This is seen as an important means of maximising air access for the Irish economy. The NAP also identified importance of ensuring that Dublin Airport has sufficient capacity, including a second, parallel runway, to facilitate its development as a hub.
- The commitments of the NAP include:
  - Creating conditions to encourage the development of new routes and services, particularly to new and emerging markets;
  - Ensuring a high level of competition among airlines operating in the Irish market;
  - Optimising the operation of the Irish airport network to ensure maximum connectivity to the rest of the world;
  - Ensuring that the regulatory framework for aviation reflects best international practice and that economic regulation facilitates continued investment in aviation infrastructure at Irish airports to support traffic growth
- The proposed night restrictions at DUB run counter to these policy objectives in that they limit growth at the airport, reduce potential new routes and services (especially to emerging markets), and do not serve to maximise connectivity.

Patterns of Demand

Patterns of Demand

Pre COVID-19 Traffic

- In 2019, prior to the COVID-19 pandemic, the Dublin schedule was dominated by short haul services to the UK and other parts of Europe (87% of flights), operated primarily by the based-carriers: Ryanair, Aer Lingus, and Aer Lingus Regional (Stobart Air). Together these carriers made up 72% of operations.
- Long-haul operations accounted for approximately 18% of total seat capacity offered out of DUB, primarily on Transatlantic routes as well as services to the Middle East, Africa and China.

Aer Lingus

- Aer Lingus had a fleet of 27 Airbus 320/321 aircraft based in DUB, 2 A320s that overnight at Heathrow, plus 2 Embraer 190 aircraft serving London City Airport. Its long haul fleet consisted of 13 Airbus 330s, 1 Airbus 321LRs and 2 B757s, serving 13 destinations in the US and Canada. The B757s were being replaced with A321LRs in 2020.
- Aer Lingus operates a hybrid business model, blending aspects of full service and low cost carrier strategies. In particular, it seeks to maximise aircraft utilisation from its DUB based fleet.
- Aer Lingus has been growing its transatlantic services in recent years, and developing DUB as a gateway Transatlantic-European hub.

Ryanair

- Ryanair operated 32 DUB-based Boeing 737-800 aircraft, and also served DUB from its other European bases with away-based flights representing 25% of its DUB operations.
- In 2019, Ryanair operated from 84 bases throughout Europe and serves 234 airports. DUB is its second largest base after Stansted. It had a total fleet of 438 aircraft in 2019, and has orders and options for 210 Boeing 737-8Max 200 airccaft[1)].
- The Ryanair LCC business model is built on achieving high aircraft utilisation, with long operating days and quick aircraft turnarounds.

(1) Ryanair 2019 Q3 report

2019 market share & capacity summary table by main DUB carrier

Main DUB Carriers	ATMs (Pax only)	Seats	Seats/ATM
Ryanair	35%	38%	189
Aer Lingus	29%	30%	189
Aer Lingus Regional	8%	3%	69
British Airways	2%	2%	167
Other Scheduled Carriers	24%	25%	186
Charter Carriers	1%	1%	189

Source: Mott MacDonald analysis of Summer 2019 schedule

2019 market share & capacity summary table by main DUB market segment

Markets	ATMs (Pax only)	Seats	Seats/ATM
1. UK London	15.5%	14.2%	166
2. UK Provincial	19.8%	14.9%	135
3. Eastern Europe	7.3%	7.7%	189
4. Western Europe	25.2%	24.5%	175
5. Southern Europe	19.4%	20.5%	190
6. North America	9.5%	13.7%	261
7. Other Regions	2.2%	4.2%	350
8. Domestic	1.1%	0.4%	59
TOTAL	100%	100%	180

Source: Mott MacDonald analysis of Summer 2019 schedule

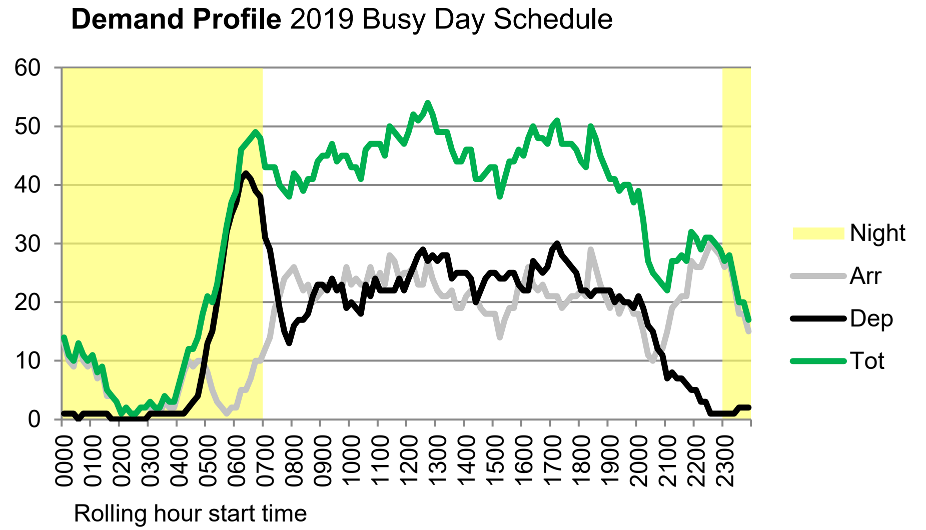
Patterns of Demand

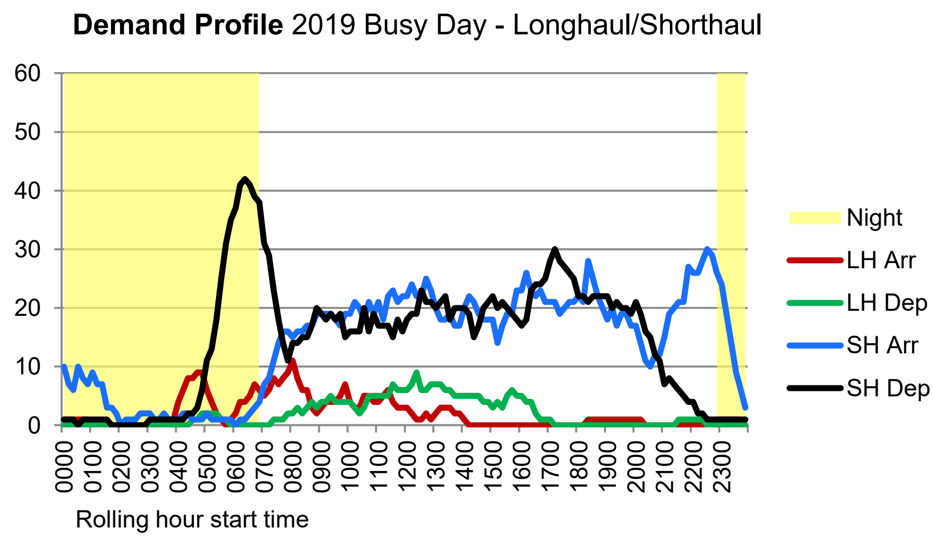
2019 Patterns of Demand

- The schedule structure at DUB reflects the business models of both Aer Lingus and Ryanair, with a high proportion of DUB based aircraft operating high utilisation short haul services.
- There is a sharp departures peak in the 06:00 hour and a broader arrivals peak between 22:00 and 00:00 associated with the first departures and last arrivals of DUB based aircraft.
- Long haul arrivals are concentrated in the morning period, with an early peak in the 05:00 hour and a broader peak around 08:00. Departures are spread from the mid-morning to early afternoon. This pattern of demand is typical of transatlantic services, where evening departures from North America fly overnight to arrive in DUB in the morning. Arrival times in DUB tend to be earlier than at other European airports due to Ireland's close proximity to North America and its time zone being 1h earlier than Central European Time.
- Between 02:00 and 05:00 there are few regularly scheduled flights – only a small number of freighter flights and some ad hoc charter flights.

Flight Connections

- Development of DUB as a transatlantic hub requires efficient flight connections. The early morning long haul arrivals connect with a large number of first-wave short haul departures operated by DUB based aircraft. These short haul aircraft return to DUB from around 09:00 and connect with the transatlantic departures, departing between 10:00 and 17:00.
- Maintaining this hub connectivity requires early morning transatlantic arrivals from 05:00 local time to facilitate Eastbound connections with short haul services departing from around 06:00. Early first-wave short haul departures are required to ensure that the returning inbound arriving flight can provide Westbound connections with the long haul departures in the mid to late morning.



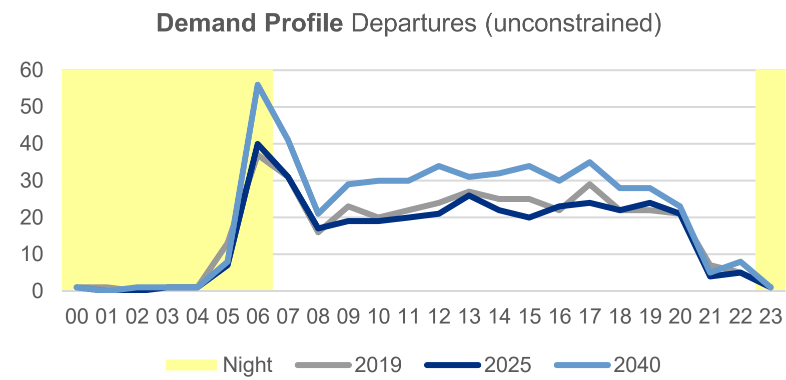


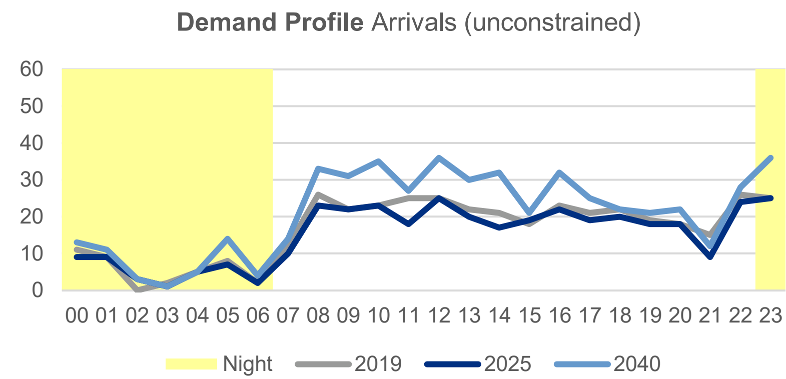
Source: Mott MacDonald analysis

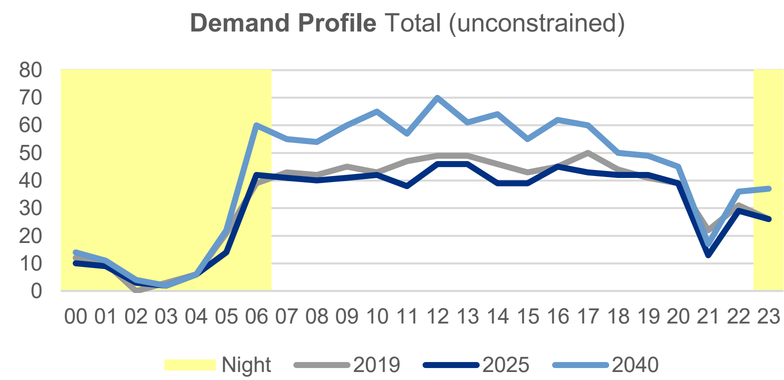
Patterns of Demand

Patterns of Demand

- The analyses of this study are based on unconstrained forecast busy day schedules. The forecast schedules represent annual throughputs during the post-Covid recovery period 2022-2025, when traffic is expected to return to the 32m annual passenger level, similar to pre-Covid levels. Long term forecast schedules are developed and analysed at 5-year increments to 2040 (ie, 2025, 2030, 2035, 2040).
- The general pattern of demand is expected to develop along similar patterns to today, with a large peak of departures demand in the 06:00 hour, representing first-wave departures on DUB-based aircraft. Arrivals is less peaky, but there is a peak of arrivals in the late evening (22:00 onwards) corresponding to the return of DUB-based aircraft. Longhaul arrivals are concentrated in the early morning period, particularly in the 05:00 hour.
- This pattern of demand provides improved connectivity for the development of DUB as a secondary hub airport, as well as providing for efficient point-to-point short haul services.
- Current (2019) schedules are constrained by the airport's single runway capacity. With the opening of the North Runway, a peakier pattern of demand is expected in the peak 06:00 departures hour (reflecting airlines' commercially and operationally ideal operating times).
- Meeting the level of departure demand in the 06:00 hour, which exceeds single-runway capacity, requires use of the North Runway in the 06:00-06:59 hour.







Source: Mott MacDonald analysis

Night Movement Demand **(23:00 – 07:00 period)**

Current Night Movements

- In Summer 2019, there were 113 regularly scheduled flights during the 23:00-07:00 period[(1)]. Short haul scheduled services make up the bulk of these night flights, with departures between 06:00-07:00 and arrivals after 23:00. There are 17 long haul night arrivals in the early morning.
- The night cargo operations are primarily flights by the package integrators DHL, FedEx, TNT and UPS operating to their main sortation hubs. These operations are very time-critical in order to connect at these hubs and to achieve an overnight package delivery service.

Future Night Movement Demand

- Busy day night movements is expected to recover to levels similar to 2019 levels with the post COVID traffic recovery by 2025.
- The table opposite also shows the degree of reduction in daily night movements that would be required to meet the 65/night operating restriction (23:00 – 07:00 period).

Dublin Forecast Night Movement Demand 23:00 – 07:00 (based on busy day schedules)

Flight Type	2019	2025	Constrained
Pax Scheduled	101	105	54
Short haul	*84*	*91*	*48*
Long haul	*17*	*14*	*6*
Pax Charter	3	2	2
Cargo	9	9	9
Scheduled sub-total	**113**	**116**	**65**
Other (ad hoc)	3	5	0
Total	**116**	**121**	**65**

(1) Based on the busy day schedule for 22 July 2019 analysed. Number of ad hoc night flights in particular will vary.

Drivers of Night Movement Demand

There are a number of reasons why airlines need to schedule services during the 23:00-07:00 night period:

Aircraft Utilisation

- A key driver of airline cost efficiency and competiveness is the ability to achieve high levels of utilisation of their aircraft assets. The chart below illustrates the lines-of-flying (flights throughout the day) for representative DUB based aircraft.
- If airlines were restricted to a 16h operating day (07:00-23:00) then the necessary level of utilisation would not be achievable, impacting on the economic viability of aircraft based at DUB. Ryanair, for example, has operating bases at a number of airports and if it could not operate profitably at DUB then it would likely choose to base more of its aircraft at other airports.
- In this case, the traffic lost is not just the night period flights but also the daytime flights that the based aircraft would have operated throughout the day.
- If high aircraft utilisation cannot be achieved due to the reduced operating day resulting from the night restrictions, then the consequence is also likely to be higher fares for passengers' on remaining services.

Time Zone Differences and Geographical location

- The 1h time difference between Ireland and mainland Europe means that flights need to leave early (before 07:00) to arrive in time for business passengers to have full working day at their destination(1).
- The geographical position of DUB means that there are longer sector distances to many European destinations than from other competing hub airports. This means that DUB requires longer operating days than competing European hubs. Similarly, DUB's proximity to North America compared to the rest of Europe means that transatlantic flights arrive earlier in DUB than at other European airports.

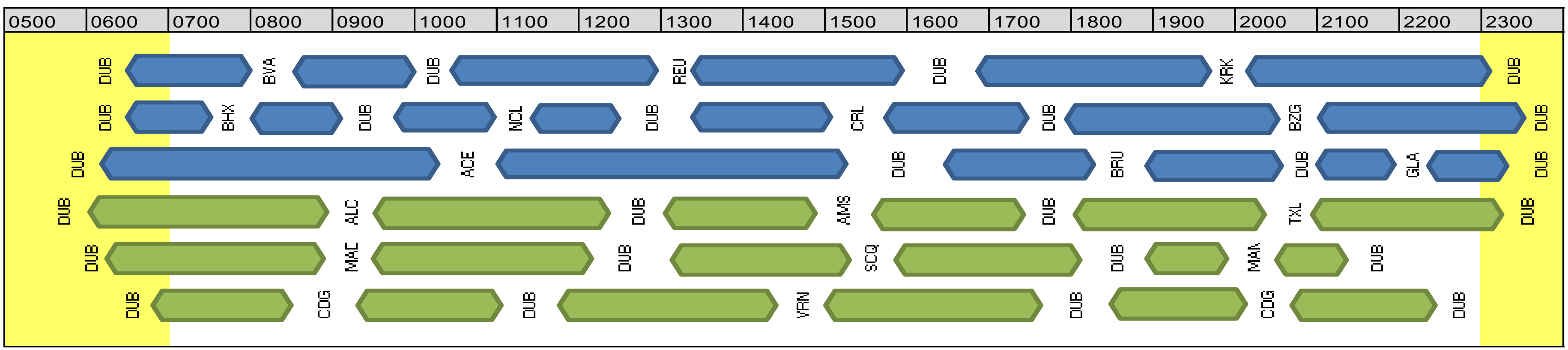
Hub Connections

- The DUB hub connecting model is predicated on early morning long haul arrivals and early short haul departures able to return to connect with the long haul departures. Without this connecting traffic, the Irish point-to-point market would be too small on its own to support many transatlantic services.

Punctuality and Resilience

- If aircraft lines-of-flying are squeezed into a shorter operating day there will be less flexibility in the schedule to cope with delays and disruption.

Illustration of Airline Airrcaft Utilisation



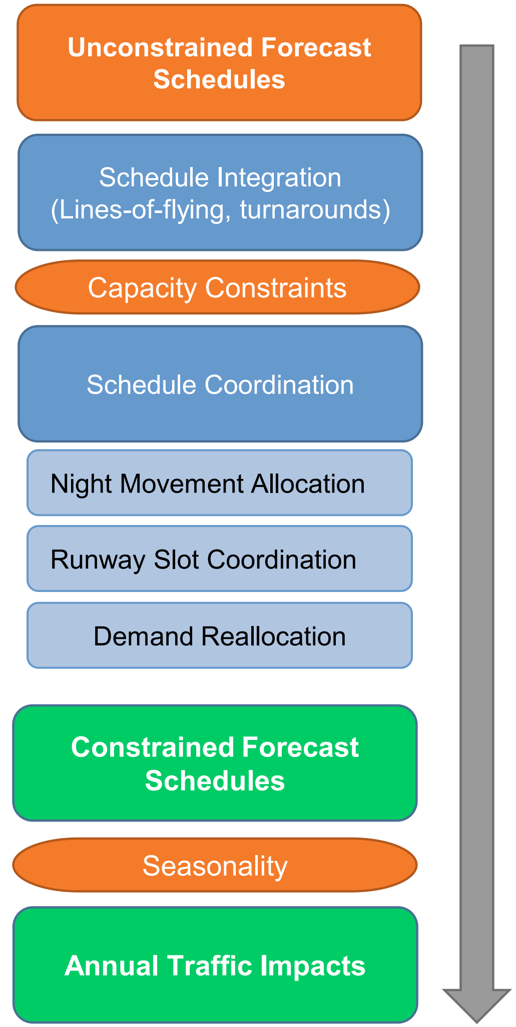
(1) From the Behaviours & Attitudes Business Barometer Survey Results 2016, 70% of business owners believe that a flight schedule facilitating arriving in time for the start of the business day is important

Constrained Case Analysis

Constrained Case Analysis

Methodology

- Quantification of the impacts of the DUB night restrictions involved development of detailed constrained busy day forecast schedules.
- The schedules assessed were unconstrained busy day forecast schedules for the period 2022 to 2040, aligned with the daa's *Centreline* annual forecast case(1). The 'unconstrained' schedules represent growth rates in line with expected passenger demand, with flights times unadjusted for any operating restrictions (ie, night restrictions or runway operating hours).
- All arriving and departure flights were linked into turnarounds, and DUB based aircraft lines-of-flying were integrated. This allowed modelling of the full impact of the night restrictions on other rotations of the same aircraft during the day.
- The schedules were coordinated within the airport's night limits and runway capacity constraints in a simulation of the slot coordination process, allocating slots in accordance with EU slot allocation rules. The coordination process sought to optimise schedules within available capacity and to ensure operationally feasible schedules.
- In applying the 23:00-07:00 night operating constraints (Condition 3d limiting to single runway operations 23:00-07:00 and Condition 5 capping night flights at 65/night), some demand for new flights could not be accommodated within capacity and were removed from the schedule. Where feasible, alternative flights were added to the schedule so as not to overstate the impact of the night restrictions being assessed.
- The process included a qualitative assessment as to how the constraints impacted on hub connectivity. Loss of connectivity could render assumed new services and routes unviable and/or delay their introduction.
- The outputs of the simulated slot coordination process were realistically constrained busy day schedules. The busy day traffic was then converted in annual equivalents in order to assess the overall impact of constraints on airport throughput.



(1) daa annual forecasts include Centreline, High and Low cases.

Constrained Case Analysis

Approach to Applying Schedule Constraints

- The process of constraining the schedule for night operating restrictions was:
  - STEP 1: the 32m / 2025 forecast schedule was constrained within the 65/night limit, allocating night slots based on the pro rata methodology discussed in the section 'Initial Night Movement Allocation' on page 21. Excess night slots were retimed into the day period where possible with adjustments made to the corresponding flights operated by the same aircraft as required. Where retimes were not possible, flights associated with the night movement (including subsequent flights operated by the same aircraft) were removed from the schedule.
  - STEP 2: the constrained 2025 schedule was treated as 'historic slots', and new flights for schedule years 2030, 2035 and 2040 were added in stages and assigned slots within remaining available capacity. Flights were retimed where necessary and where feasible. For each year, the previously coordinated years' flights were treated as 'historic slots' to provide a realistic simulation of the slot coordination process.
  - STEP 3: if flights could not be accommodated due to the operating restrictions and no feasible alternative slot times were available, they were removed from the schedule. The corresponding arrival or departure flights associated with the same aircraft rotation or line-of-flying were also removed from the schedule.
  - Given that the 65/night limit was fully used under the constrained 2025 schedule, no new night slots were assigned in subsequent years.
- For scenarios with the 32m passenger cap, schedule growth was capped at the busy day equivalent of 32m annual passengers, following the growth trajectory of the equivalent uncapped scenario (ie, with or without night restrictions) up to the 32m traffic level.
- For all scenarios (except for Scenario A – daa input schedules), flights are coordinated to fit within the physical runway capacity of the airport, expressed as hourly and 10-minute limits

Retiming Criteria

- For short-haul, the criteria for retimes was based on operationally and commercially feasible timings, considering the whole line-of-flying for each based aircraft. If it was not possible to accommodate the full number of aircraft rotations and maintain aircraft utilisation, all aircraft rotations associated with the line of flying were removed from the schedule.
- For long haul services, retimes of up to 90 minutes were generally considered possible, but feasibility was checked against the timings at the other end of the route. Where retiming was not possible, the affected arrival/departure flight pairs were removed from the schedule.
- The timing adjustments were checked for their feasibility in terms of commercial timings for the route, considering benchmark operations at both DUB and at comparable European airports.
- Timing adjustments also ensured that airline minimum turnaround times for the specific aircraft type were respected.

Airline Engagement

- As part of earlier iterations of this study, meetings were held with Aer Lingus and Ryanair to understand their strategies with regard to network, route and fleet development, the key criteria for scheduling services at DUB, and understanding the importance of night operations to their businesses.
- This input has been incorporated into the approach to constraining the forecast DUB schedules to make them as realistic as possible. The constrained schedules were developed by Mott MacDonald in a simulation of the slot coordination process.

Capacity Constraints

Night Restrictions (23:00 – 07:00 night period)

- The 23:00-07:00 night restrictions period applies to landing and takeoff times. Schedules are based on on/off stand times, so an allowance needs to be made for taxi times.
- The 65/night limit applies to actual runway operations, including unplanned night flights (e.g., delayed flights). Therefore it is prudent to apply buffers to the night restrictions period to allow for modest delays. This will not prevent excessive night use on disrupted days, but will minimise such occurrences. These buffer times have been benchmarked against other airports with night restricted periods, and incorporate the views of the DUB-based carriers consulted as part of this study regarding prudent scheduling buffers for night-restricted airport operations.

Night Slot Periods:

Arrivals	22:45 to 07:10 on blocks time
Departures	22:30 to 06:45 off blocks time

Note:

The above night-slot definition means that the latest arrival day-slot is 22:40 on block time (equivalent to a 22:30 landing time), giving a 30 minute buffer for operational delays. The earliest arrival day-slot is 07:15 on block time to ensure landing after 07:00.

The latest departure day-slot is 22:25 off blocks time, giving approximately a 30 minute buffer for operational delays. The earliest departure day-slot is 06:50, with takeoff after 07:00, accounting for the outbound taxi time.

Capacity Constraints

Runway Capacities

- The table opposite details the runway capacities assumed for this study.
- The hourly capacities are based on:
  - Single runway mixed mode operations at night
  - Segregated mode (separate arrival and departure runways) during non-peak daytime hours
  - Semi mixed mode at peak times, with one runway operating in mixed mode (both arrivals and departures) and the other runway handling either arrivals or departures depending on the demand peak.
- In addition to hourly limits, a 10 minute scheduling constraint is applied to smooth demand within each hour.

Assumed Runway Capacities

	Arrivals	Departures	2-way
Single Runway – Night (3)			
60 minute	27	27	45
10 minute	6	6	9
Segregated Mode – Daytime except peaks			
60 minute	35	44	79
10 minute	7	8	15
Semi Mixed Mode – Departures Peak (1)			
60 minute	27	71	89
10 minute	5	12	15
Semi Mixed Mode – Arrivals Peak (2)			
60 minute	62	27	80
10 minute	11	5	15

Notes:
(1) For scenarios with Condition 3d – 23:00-07:00 single runway operations (Scenarios B, and E), the departures peak is 07:00-07:59; for scenarios without Condition 3d (Scenarios A, C, D), the departures peak is 06:00-06:59
(2) For all scenarios, the arrivals peak is 22:00-22:59

Night Movement Allocation

Initial Night Movement Allocation

- The number of regularly scheduled night flights on a typical busy day for 2025 (based on a Summer 2020 pre COVID impact busy day) is 116 flights (plus ad hoc non-scheduled movements). Implementing the 65/night restriction requires a 44% reduction in current scheduled demand.
- The assumed demand reductions were made by applying pro rata reductions by airline of up to 50%, with an exemption for airlines with only 1 night flight. An exception to this general rule applies to airlines with flights scheduled close to the edge of the night restrictions period and where a retiming out of the night was assumed to minimise overall impacts.
- The consequence of this approach is that the demand reduction falls primarily on the Irish based carriers with night movements:, Aer Lingus and Ryanair.
- Flights were chosen in order to minimise the amount of timing adjustment required, for example, by moving flights from the edge of the night restrictions period into the daytime period. Consideration was given to the aircraft lines-of-flying to ensure operational feasibility and to ensure that minimum ground times for aircraft turnarounds were respected.
- Since demand in 2025 is already in excess of 65/night, any new demand for night flights arising after the 2025 night allocation cannot be offered a night slot.

Dublin Baseline Night Movement Allocation

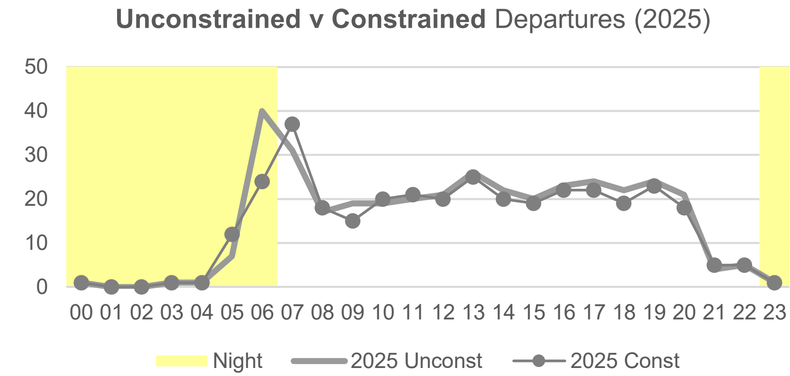
Carrier	Flight Type	2025 Demand	2025 Allocation	Reduction	
Aer Lingus	Pax Scheduled	41	21	-49%	
Ryanair	Pax Scheduled	47	23	-51%	
Stobart	Pax Scheduled	2	0	-100%*	Minor retime
Air Moldova	Pax Scheduled	1	1	0%	
Aegean	Pax Scheduled	2	1	-50%	
Air France	Pax Scheduled	1	1	0%	
Cathay Pacific	Pax Scheduled	1	0	-100%*	New after 2022
Ethiopian Airlines	Pax Scheduled	4	3	-25%	
KLM	Pax Scheduled	1	1	0%	
Lufthansa	Pax Scheduled	3	2	-33%	
Aeroflot	Pax Scheduled	1	1	0%	
United Airlines	Pax Scheduled	1	0	-100%*	10min retime
Tomsonfly	Pax Charter	2	2	0%	
TNT	Cargo	1	1	0%	
Bluebird Cargo	Cargo	1	1	0%	
FedEx	Cargo	1	1	0%	
DHL	Cargo	2	2	0%*	Retime not possible
UPS	Cargo	2	2	0%*	Retime not possible
XM Cargo	Cargo	2	2	0%*	Retime not possible
Total		**116**	**65**	**-44%**	
GA/Positioning		5			
Total		**121**			

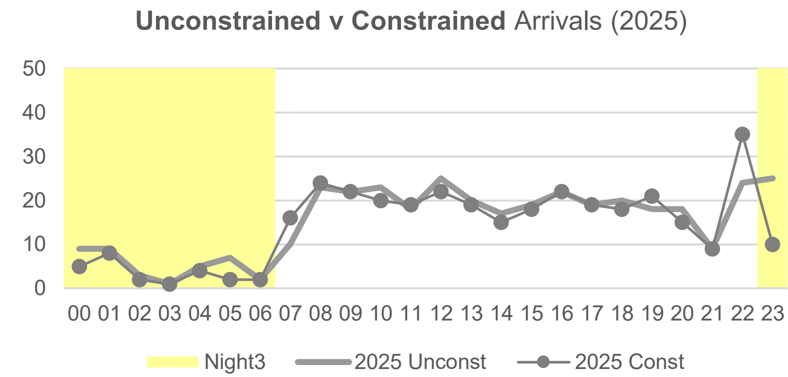
Scenario Summaries

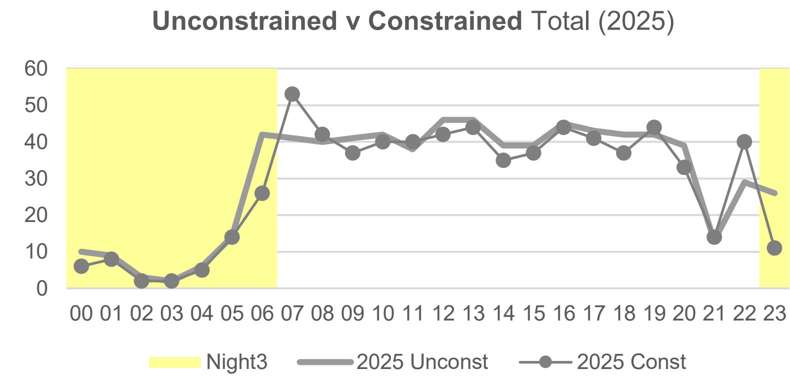
Constrained Case Summary

Slot Allocation Summary

- The charts opposite show Constrained schedule – Scenario E applying both the night operating restrictions (Conditions 3d and 5) compared with the unconstrained pattern of demand, but limited to 32m annual passengers in 2025 (Scenario D).
- The 65/night limit requires flights to move out of the 23:00-07:00 period. This shifts the arrivals peak from the 23:00 hour into the 22:00 hour, creating a more pronounced peak overall.
- The departures peak shifts from the 06:00 hour to the 07:00 hour. There is also a peak in total movements in the 07:00 hour, in excess of unconstrained demand, due to flight bunching outside the night period.
- Overall the night operating restrictions constrained case has 40 fewer busy day flights (-5.4%) in 2025 as a result of impacted night flights that could not be realistically retimed.



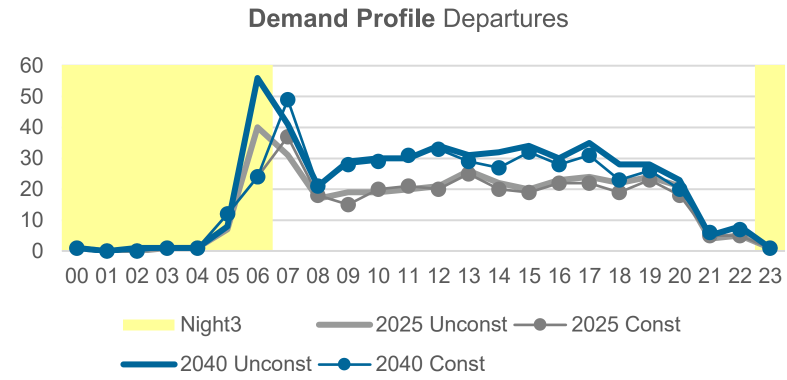


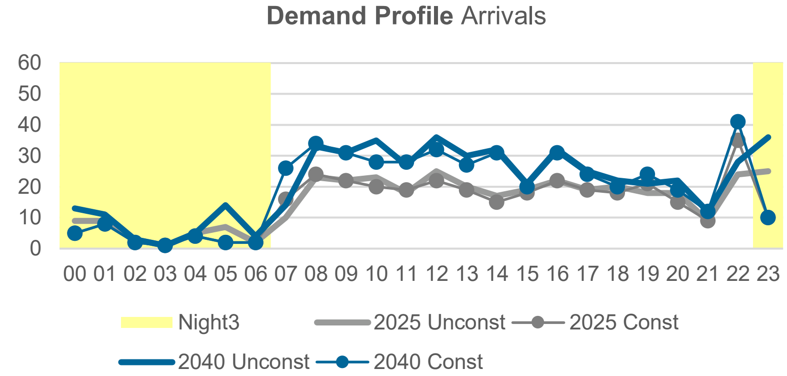


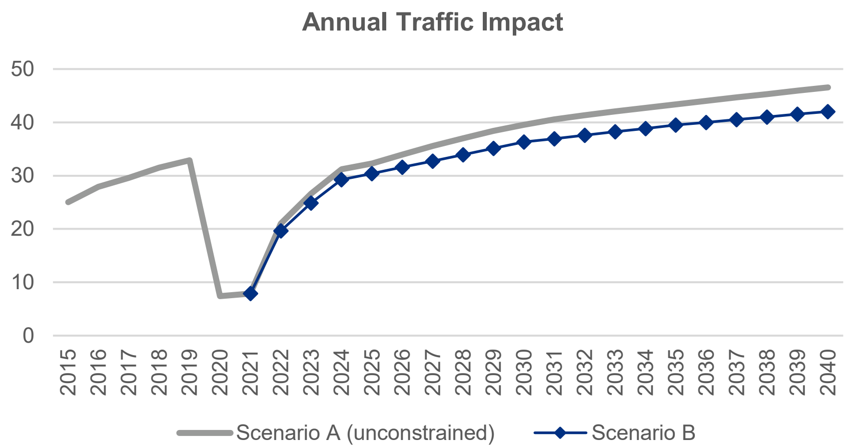
Source: Mott MacDonald analysis

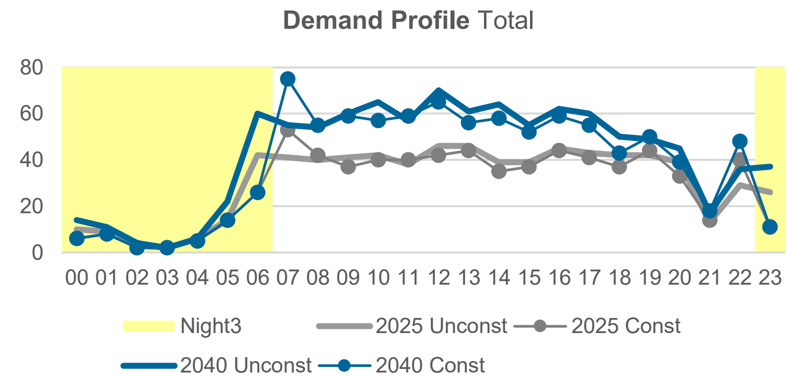
Scenario B Summary
2300-0700 65/night limit – no passenger cap

- The charts opposite show the effect of the slot coordination exercise on patterns of demand for the 2025 and 2040 forecast schedules, compared with the daa input schedules (Scenario A).
- Condition 3d and 5 night planning conditions result in a shift of the peak departures from the 0600h to the 0700h, and of arrivals from the 2300h to the 2200h.
- The overall size of the schedule is 10% smaller in 2040 due to the effect of the night restrictions





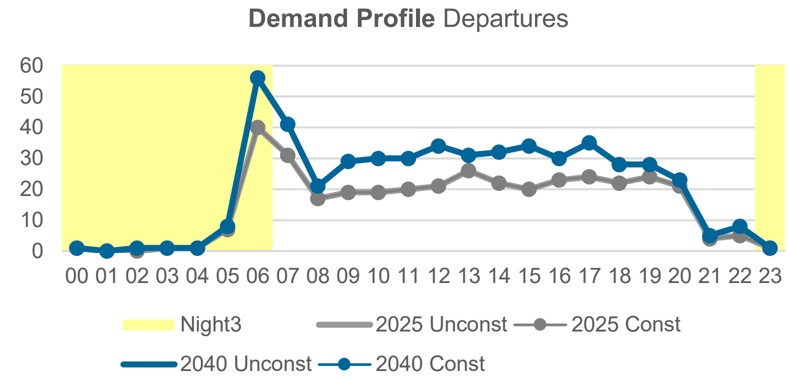


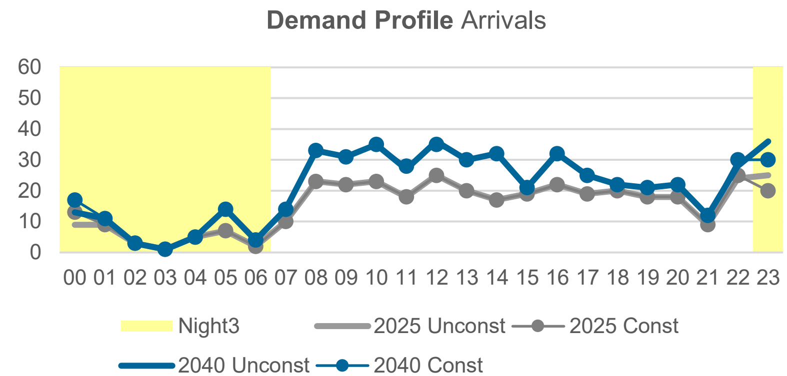


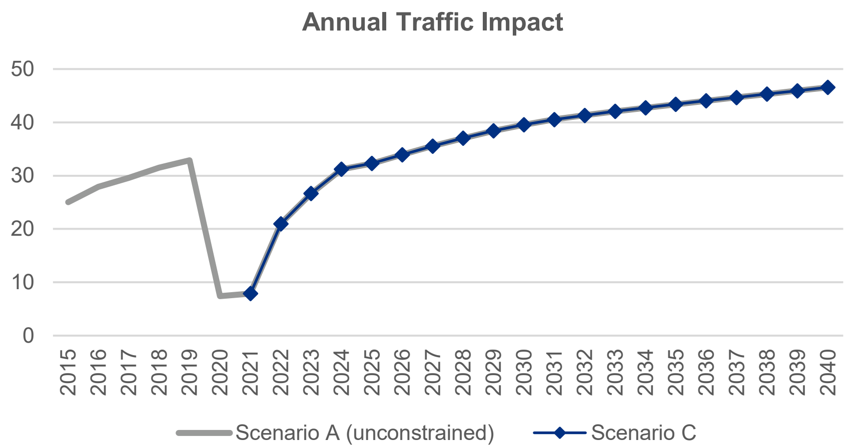
Source: Mott MacDonald analysis

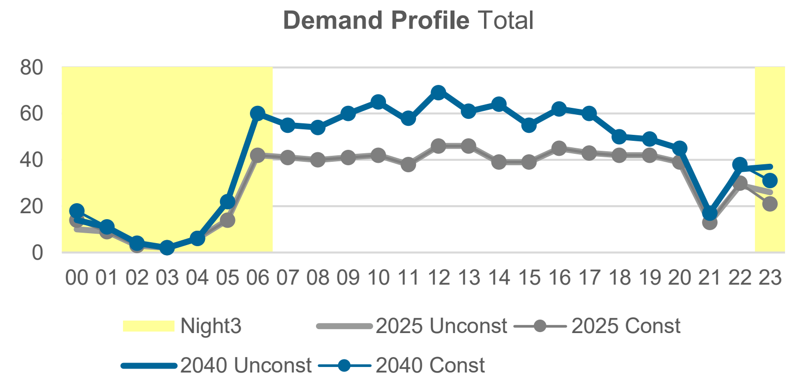
Scenario C Summary
Runway limits only, no planning conditions

- ► The charts opposite show the effect of the slot coordination exercise on patterns of demand for the 2025 and 2040 forecast schedules , compared with the daa input schedules (Scenario A).
- ► Without the Condition 3d and 5 night planning conditions, the capacity-coordinated schedules are in line with daa input schedule demand. Runway capacity is sufficient to meet demand, with only minor schedule adjustments to smooth schedules within the 10-minute slot constraints.





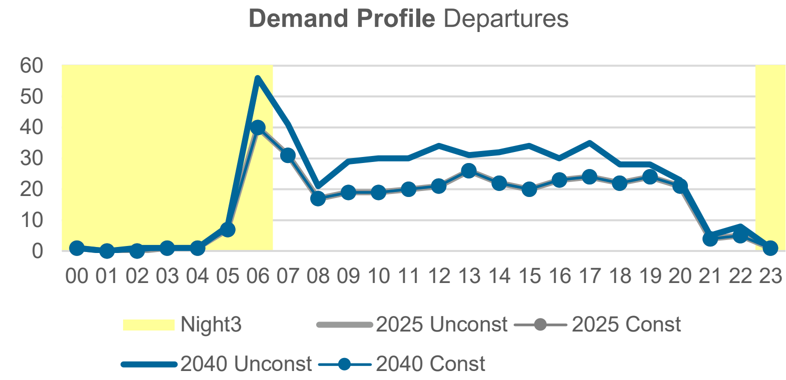


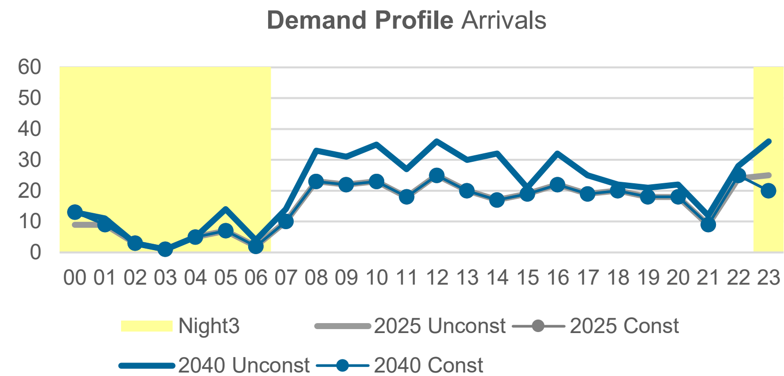


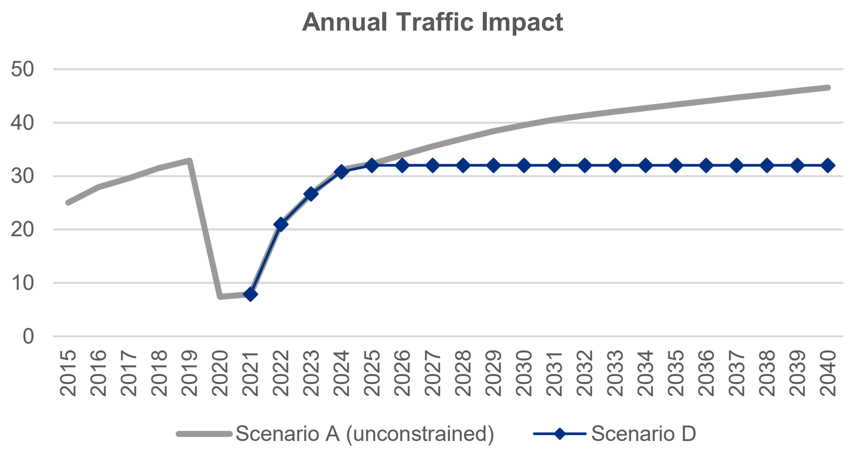
Source: Mott MacDonald analysis

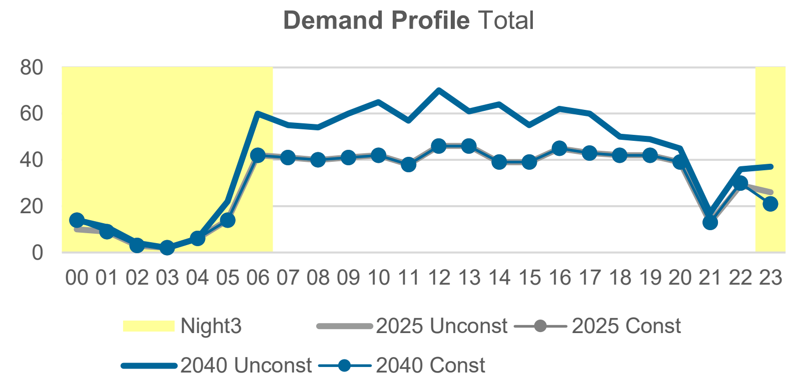
Scenario D Summary
32m pax cap, no night limits

- The charts opposite show the effect of the slot coordination exercise on patterns of demand for the 2025 and 2040 forecast schedules , compared with the daa input schedules (Scenario A).
- The effect of the 32m passenger limit is to cap the schedules at approximately 2025 levels (post Covid recovery).
- The overall size of the schedule is 31% smaller in 2040 due to the effect of the passenger cap





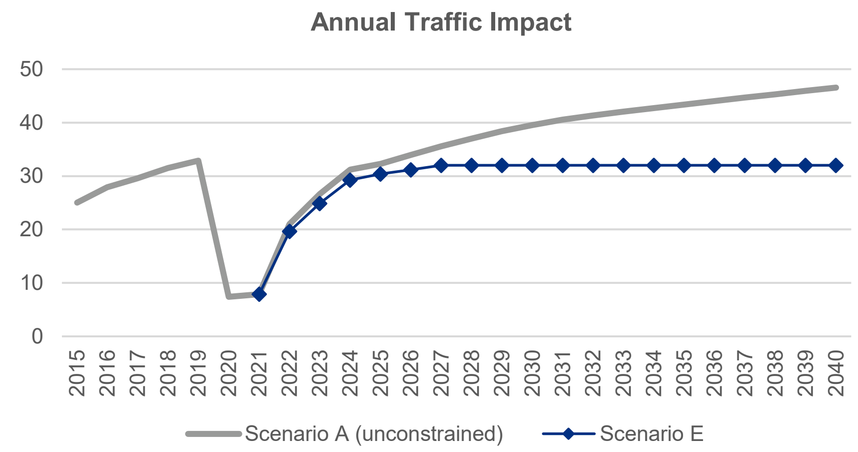


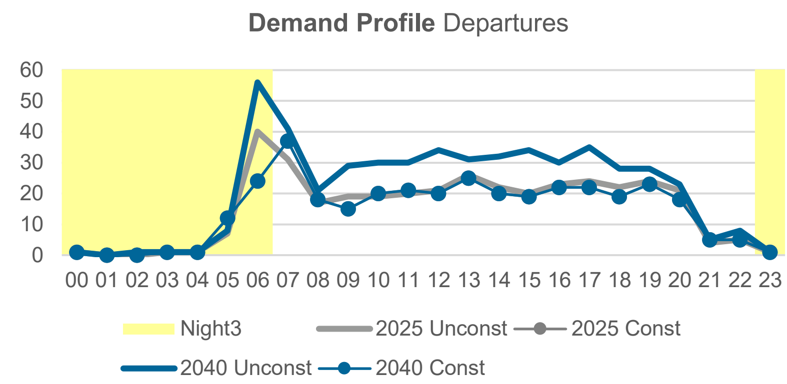


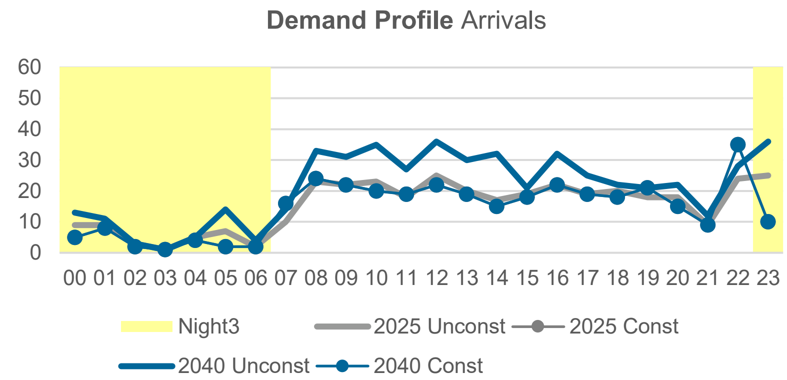
Source: Mott MacDonald analysis

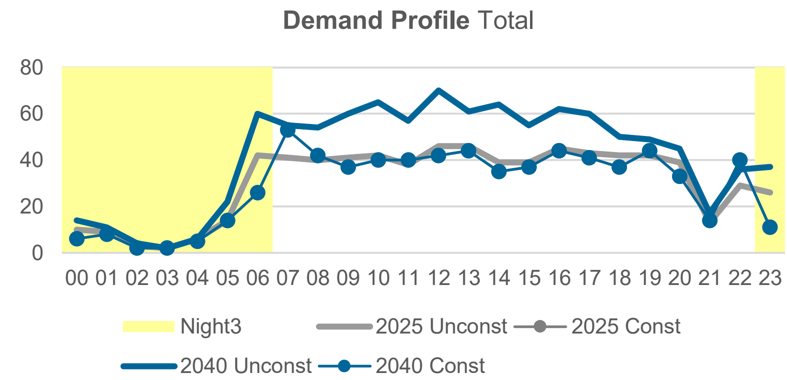
Scenario E Summary
2300-0700 65/night limit – 32m pax cap

- The charts opposite show the effect of the slot coordination exercise on patterns of demand for the 2025 and 2040 forecast schedules , compared with the daa input schedules (Scenario A).
- Condition 3d and 5 night planning conditions result in a shift of the peak departures from the 0600h to the 0700h, and of arrivals from the 2300h to the 2200h.
- The effect of the 32m passenger limit is to cap the schedules at approximately 2025 levels (post Covid recovery).





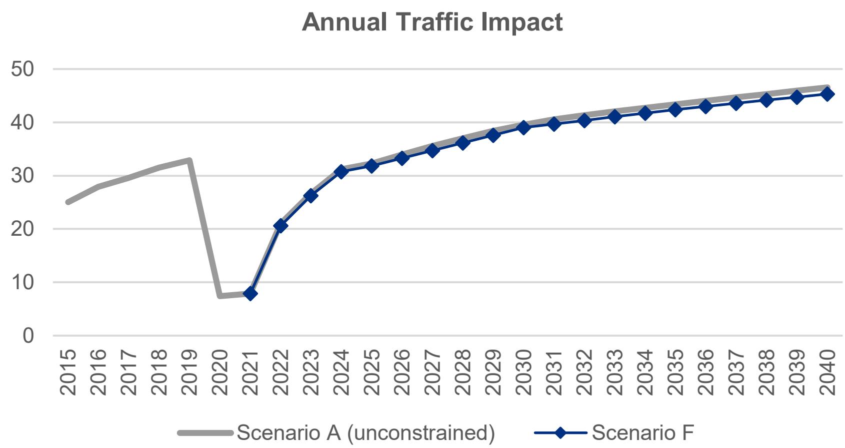


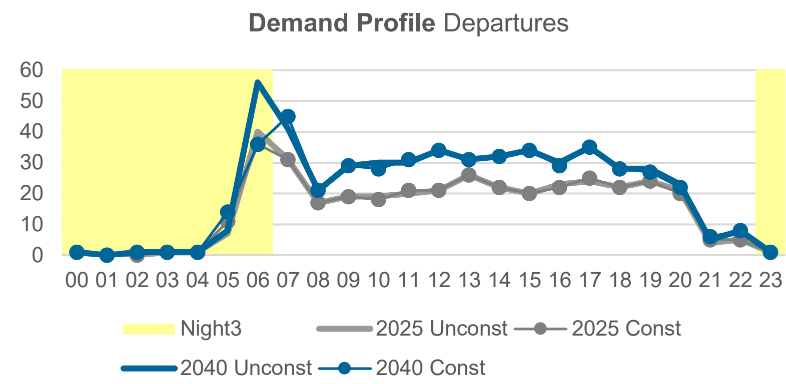


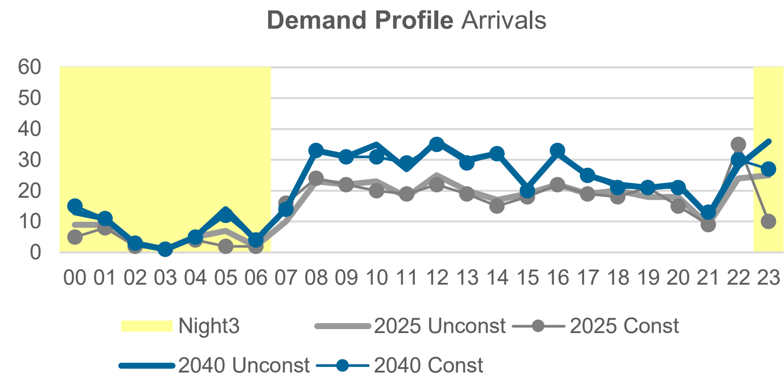
Source: Mott MacDonald analysis

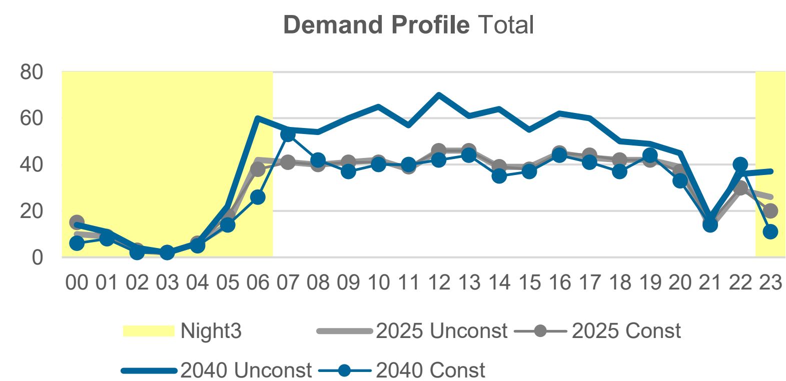
Scenario F Summary
2300-0700 Single Runway
(no 65/night or 32m pax limits)

- The charts opposite show the effect of the slot coordination exercise on patterns of demand for the 2025 and 2040 forecast schedules , compared with the daa input schedules (Scenario A).
- Condition 3d and 5 night planning conditions result in a shift of the peak departures from the 0600h to the 0700h, and of arrivals from the 2300h to the 2200h.
- The effect of the 32m passenger limit is to cap the schedules at approximately 2025 levels (post Covid recovery).









Source: Mott MacDonald analysis

Fleet Modernisation

Fleet Modernisation

Introduction

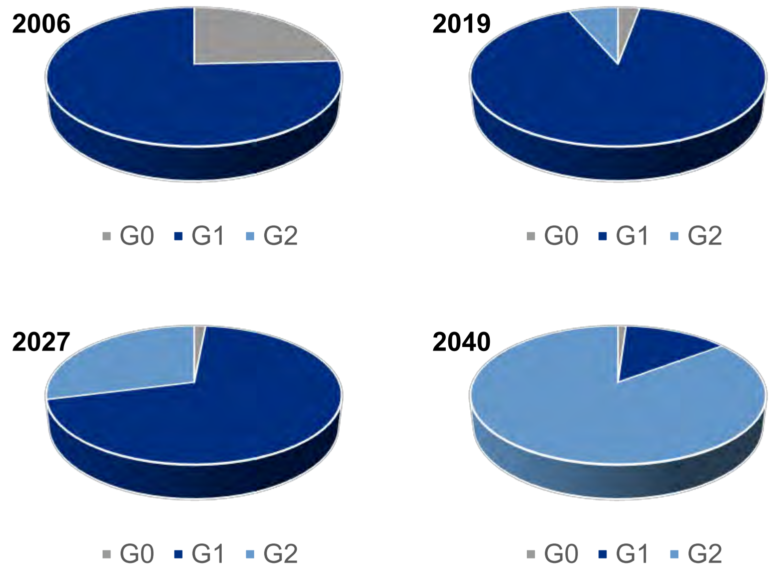
In 2019, around 91% of DUB operations use the current generation (G1) aircraft types, with 3% of movements operated by older aircraft (G0) and 6% of movements operated by the most modern (G2) types.

Our study predicts that the current G1 aircraft types will be largely replaced on a phased basis by next generation G2 types by 2040.

The main period for fleet renewal is between 2027 and 2040, although this analysis is sensitive to the timing of Ryanair's replacement of its current DUB fleet of B737-800s with new B737-8 MAX 200s.

This study analyses the expected evolution of the DUB fleet during the 2025 – 2031 time horizon, taking account of the impacts of the COVID-19 pandemic on the aviation industry. Fleet evolution is extended to 2037 for the 40m annual passenger schedule with 23:00-07:00 night operating constraints (under Constrained Scenario 1).

DUB Fleet Evolution 2006 - 2040



Source: Mott MacDonald analysis of daa data and schedules (2006, 2019), Mott MacDonald projections (2027, 2040)

Note on Aircraft Generation Categorisation
For the purposes of these analyses, aircraft have been categorised into generations of aircraft technology:

- **Generation 0 (G0) –** Older aircraft types, typically developed in the 1970s or 1980s and now generally out of production, eg, B737 Classic (300/400/500), B757, B767, A300, A310
- **Generation 1 (G1)** – Current aircraft types, typically developed in the 1990s or 2000s and still in production, eg, B737NG (700/800/900), B777, A320 series, A330, A340, A380, Bombardier CRJ, Embraer EJets, Avro RJ, Bombardier Q400, ATR42/72
- **Generation 2 (G2)** – Latest aircraft types recently entering production or under development, eg, B737MAX, B787, B777X, A320neo, A330neo, A350, Bombardier Cseries/Airbus A220, Embraer Ejet-E2, Sukoi Superjet
- **Generation 3 (G3)** – Further new-generation aircraft types not yet in development.

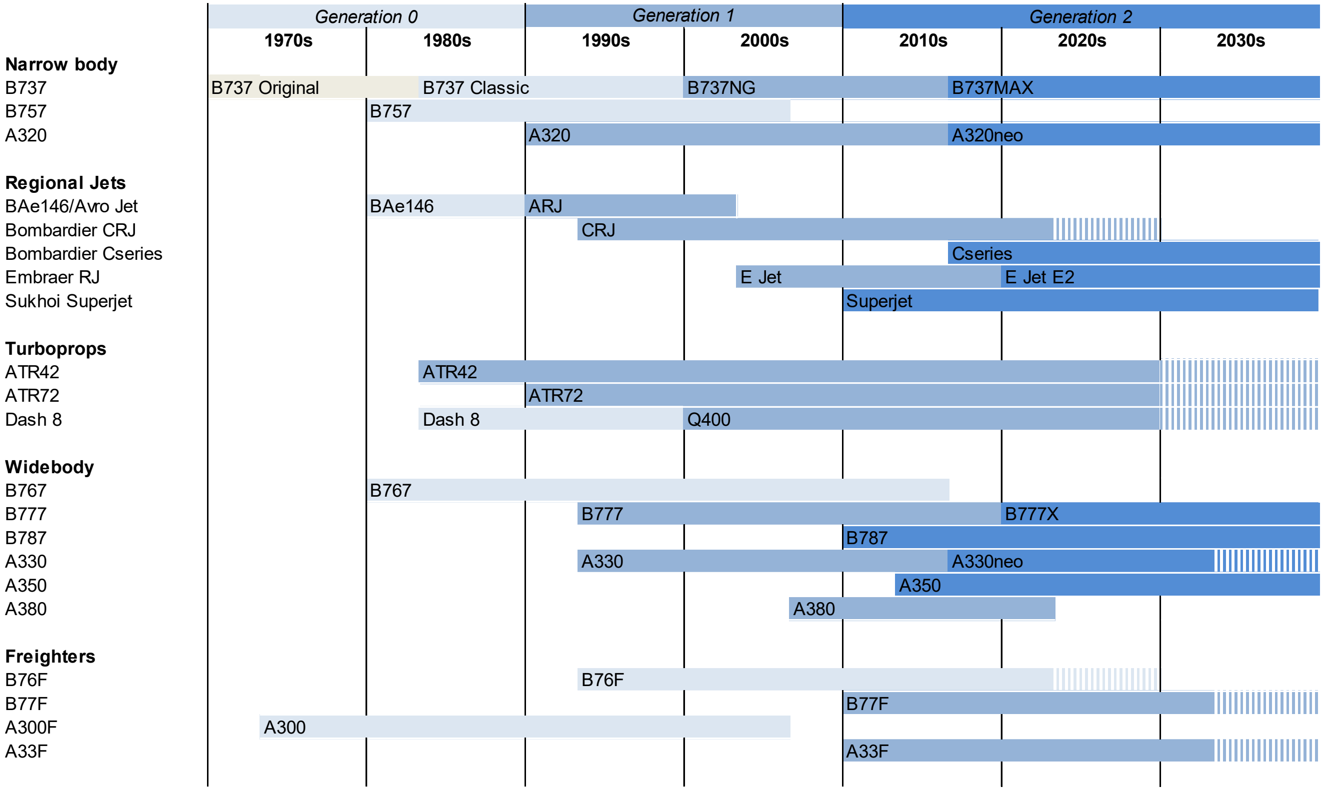
Aircraft Manufacturers' Development and Production Cycle

Aircraft development cycle

- The development of commercial transport aircraft represents large capital investments for the aircraft manufacturers, and typically follows a 20-30 year cycle between generations of aircraft types.
- The pace of aircraft development depends on the rate of improvement in technology (eg, engine efficiency), with new types typically seeking to achieve a 20% improvement in seat-kilometre costs over previous generation competitors.
- Another factor which influences manufactures' commitment to new aircraft development is competition between manufactures. For example, Airbus' development of the A350 and A330neo was spurred by the sales success of Boeing's B787. Similarly, Boeing's launch of the B737MAX was a response to Airbus' A320neo programme.
- Once in service, aircraft have an operational lifespan of around 25 years in mainline service, and longer as freighter conversions and as niche charter aircraft. In times of low oil prices, the life of older aircraft types may be extended.
- As a consequence, an aircraft type may be in active service over 50 years after its initial development. For example, the A320 first went into service in 1988, and is still in production. A newly-manufactured A320 entering airline service now is likely to still be flying until the early 2040s.

Commercial Aircraft Production Cycle

Dates of aircraft types in production by generation



Source: Mott MacDonald analysis, select aircraft types relevant to DUB

DUB Fleet renewal

COVID-19 Impacts

The worldwide spread of the COVID-19 pandemic in March 2020, lockdowns and restrictions on air travel has led to a crisis in the aviation industry and a recession in the general economy. The DUB recovery scenario for this study assumes traffic returns to 2019 levels of around 32m by 2025.

Global Impacts

The demand/capacity and financial aspects of the COVID-19 crisis is having two types of impact on airline fleets:

- Firstly, some airlines are accelerating the retirement of older aircraft, which tend to be less fuel efficient and noisier
- Secondly, some airlines are deferring the ordering and delivery of new aircraft types(*), which tend to have better environmental performance

Therefore, compared with pre-crisis projections, there is likely to be a short-term improvement in average environmental performance of global airline fleets due to early retirement of older aircraft, but a slower medium-term (next 5 years) improvement due to fewer latest-generation aircraft type deliveries.

(*) Note: the deferral of new aircraft deliveries is due mainly to slower airline growth in the next few years. Airlines are still expected to replace older, life-expired aircraft at the end of their economic life (around 20-30 years' of service).

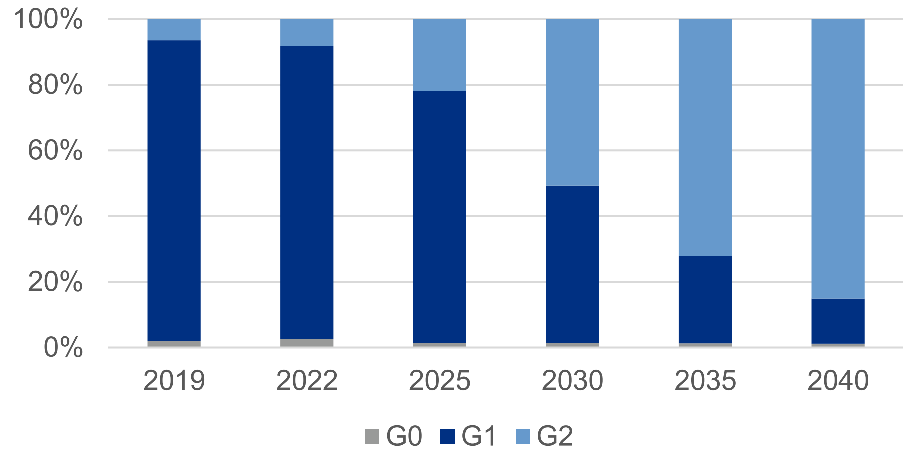
Dublin Airport Fleet Renewal

The chart below shows the evolution of DUB fleet during the period to 2040 considered in this study.

Overall, there is modest modernisation of the DUB fleet by 2025, with the proportion of latest generation aircraft types (G2) increasing from 7% in 2019 to 22% in 2025 due to the replacement of life-expired aircraft types.

The bulk of the modernisation is expected to occur after 2025. The fleet renewal analysis and assumptions of this study take into account the reduced new aircraft production expected as a consequence of the COVID-19 pandemic and its impact on the aviation industry.

DUB Fleet Evolution 2019 - 2040



Source: Mott MacDonald analysis of daa data and schedules (2019), Mott MacDonald projections (2022 onwards)

Airline Fleet Renewal

Aer Lingus

Shorthaul fleet

- The Aer Lingus (EI) current shorthaul fleet of A320/321 aircraft are expected to be replaced with A320/321neos on a phased basis as they reach 24 years in service[(1)]. This replacement cycle is not expected to be impacted by the COVID-19 crisis.
- Six of EI's shorthaul aircraft (16% of the fleet) were delivered 1998-2001, so are due for replacement by 2025. The remainder were delivered 2004-2011, so will be replaced on a phased basis between 2028-2035.

Longhaul Fleet

- EI currently operate A330 widebody and A321neo LR narrowbody aircraft types for their longhaul services.
- Three of the A330s were delivered 1999-2001, so are due to be replaced at 24 years' service by 2025. The remainder were delivered 2007-2017, so are not due to be replaced until the 2030s. The A321neo LRs are new aircraft (from 2019), so will not be replaced before 2040.
- Our April 2019 analysis assumed EI's future longhaul fleet would be evenly split between narrowbody (A321neo LR) and widebody (A330neo/A350) aircraft types by 2040. In general, the impact of the COVID-19 crisis and general trends in the aviation industry is likely to favour greater use of narrowbody aircraft on transatlantic routes from DUB, so the A321LR share of EI's fleet may be higher than 50% in future. More use of smaller A321LR aircraft would reduce environmental impacts (CO2 and noise) compared with the 50/50 assumption of this study.

(1) Aer Lingus advised to assume 24 year service life for A320/321s and A330s

Ryanair

- In 2019, Ryanair had a fleet of over 450 B737-800s and 1 B737-700, with 32 of the B737-800s (7%) based at DUB. The B737-800s were delivered between 2002-2018 and are assumed to retire after 20 years' service[(1)].
- Ryanair has orders and options for 210 of the new B737-8 MAX 200s, due for delivery over a 5-year period.
- The B737MAX has been grounded since March 2019 following two accidents related to its flight control systems. However, the B737MAX has now been approved by the FAA and resumed operations in early 2021.
- Ryanair has stated publicly that it still intends to take delivery of its full order of B737MAX aircraft.
- Our fleet modernisation analysis assumes that Ryanair will switch its DUB base to B737MAX mainly after 2025 (but before 2030). Even with two-year delayed MAX deliveries, Ryanair could have enough MAX in its fleet to switch DUB as early as 2023, but a post-2025 fleet renewal was deemed consistent with a 'centreline' forecast case.
- If Ryanair were to upgrade to MAX aircraft by 2025, this would result in a 1.5% uplift in seat capacity at the airport, potentially increasing annual throughput in 2025 from 32.3m to about 32.8m

Other Airlines

- Fleet renewal assumptions for other airlines were based on replacement at around 25 years' service for passenger aircraft and around 30 years' service for freighter aircraft.
- These assumptions are not likely to be significantly affected by the COVID-19 crisis and are consistent with a 'centreline' case forecast.

(1) Ryanair operates a young fleet to reduce maintenance costs, hence the shorter 20 year service life assumed for the B737-800s. The B737-700 is used as a corporate charter aircraft in winter and training/backup aircraft in summer. It therefore achieves less annual utilisation and a longer in-service life is assumed.

Annual Traffic Impact

Annual Traffic Impact

Impact of Operating Restriction Scenarios

- This study has developed busy day forecast schedules and analysed the impacts of operating restrictions for four scenarios, in addition to the original daa input schedule, as summarised in the tables opposite.
  - **Scenario A** is the daa input busy day forecast schedules, aligned with the Centreline annual forecast case. Flights are timed at commercially and operationally 'ideal' timings and are not smoothed to fit within airport capacities
  - **Scenario B** applies the current North Runway night operating restrictions (the 65/night limit and no use of the North Runway 23:00-07:00), but does not apply the 32m annual passenger cap

    The night restrictions severely limit traffic growth, delaying post-Covid recovery to 2019 traffic levels by around 2 years (from 2025 to 2027).
  - **Scenario C** is an unconstrained schedule with no night limits or annual passenger cap. The daa input schedule (Scenario A) has been coordinated within the physical runway capacity constraints, adjusting flight times to smooth demand, but Scenario C has the same volume of flights as the daa input schedule. The runways are assumed to operate in mode Option 7b (see page 8) and according to the capacities discussed in Section 3 (page 20) of this report.

    Runway capacity is sufficient to accommodate the full daa input forecast schedule with relatively minor schedule timing adjustments. Unconstrained annual forecast passengers can be accommodated
  - **Scenario D** applies the 32m annual passenger cap to the runway capacity coordinated schedules of Scenario C, but does not apply the night operating restrictions (Conditions 3d and 5)

    The 32m passenger level is reached in 2025. The 32m cap begins to have an impact from 2024 as traffic growth approaches the 32m capped level asymptotically
  - **Scenario E** applies the 32m annual passenger cap to the night operating constrained schedule of Scenario B.

    The 32m passenger level is reached around 2027
  - **Scenario F** applies the restriction to operate one runway only 23:00-07:00, but without the 65/night movement cap and without the 32m annual passenger cap.

    Constrained runway capacity in the 06:00-07:00 hour for first-wave departures limits growth in DUB-based aircraft flying

Scenario	Condition 3d (single runway)	Condition 5 (night limits)	32m cap	Description
A	na	None	No	*daa input schedule*
B	2300-0700	65/night	No	*Night limit constraints*
C	2300-0600	None	No	*Unconstrained (runway capacity only)*
D	2300-0600	None	Yes	*32m cap only*
E	2300-0700	65/night	Yes	*Night limits + 32m cap*
F	2300-0700	None	No	*Single runway 2300-0700 only*

Scenarios	A	B	C	D	E	F
2015	25.0					
2016	27.9					
2017	29.6					
2018	31.5					
2019	32.9	32.9	32.9	32.9	32.9	32.9
2020	7.4	7.4	7.4	7.4	7.4	7.4
2021	7.9	7.9	7.9	7.9	7.9	7.9
2022	21.0	19.6	21.0	21.0	19.6	20.6
2023	26.7	24.9	26.7	26.7	24.9	26.2
2024	31.2	29.3	31.2	30.8	29.3	30.8
2025	32.3	30.4	32.3	32	30.4	31.9
2026	34.0	31.6	34.0	32	31.2	33.3
2027	35.6	32.8	35.6	32	32	34.7
2028	37.0	33.9	37.0	32	32	36.2
2029	38.4	35.1	38.4	32	32	37.6
2030	39.6	36.3	39.6	32	32	39.0
2031	40.5	37.0	40.5	32	32	39.7
2032	41.3	37.6	41.3	32	32	40.4
2033	42.1	38.2	42.1	32	32	41.0
2034	42.7	38.9	42.7	32	32	41.7
2035	43.4	39.5	43.4	32	32	42.4
2036	44.0	40.0	44.0	32	32	43.0
2037	44.7	40.5	44.7	32	32	43.6
2038	45.3	41.0	45.3	32	32	44.2
2039	46.0	41.5	46.0	32	32	44.7
2040	46.6	42.0	46.6	32	32	45.3
Traffic Impact						
2022-2025	-	-7.0	0.0	-0.7	-7.0	-1.7

Source: Mott MacDonald analysis, based on daa Centreline *forecast scenario*

Annual Traffic Impact

Impact of Operating Restrictions

- It should be noted that the estimated impacts of the capacity and planning constraint scenarios discussed above were developed to be as realistic as possible, and to simulate the normal seasonal slot coordination process. It seeks to provide a 'mid case' or 'most likely case' impact assessment, neither overstating nor understating likely impacts.
- The assessments assume that airlines are willing and able to accept alternative slot times outside of the 23:00-07:00 night period, which would be commercially and/or operationally suboptimal. In the post-Covid recovery period, weak passenger demand is likely to mean that airline flexibility is reduced – when demand is weak, airlines are able to accept fewer suboptimal flight timings before services are no longer profitable. Dublin Airport operates in a competitive environment, so if services at DUB are less profitable than alternative airports in the UK and EU, due to onerous planning constraints, airlines will redeploy their aircraft capacity elsewhere.
- The burden of the night restrictions falls mainly on the DUB-based Irish carriers Aer Lingus and Ryanair. The DUB-based carriers require early morning departures and late evening arrivals for their short haul operations, and Aer Lingus requires early morning arrivals for its transatlantic operations. Non-Irish carriers are less affected by the restrictions as they have proportionately fewer operations in the restricted 23:00-07:00 period.
- The operating restrictions constrain growth in short haul operations throughout the day, as the lack of night slots limits the number of DUB-based aircraft that can be accommodated, with each aircraft performing multiple flights during the operating day.
- Without constraining night operating restrictions and if dual runway operations are possible 06:00-23:00, then the runway capacity limits are sufficient to accommodate unconstrained demand up to the 46m annual passengers analysed for 2040, with only minor schedule timing adjustments (see Scenario C).

Note: Annualised traffic impacts for each scenario are derived from each constrained scenario's busy day forecast schedule, where flights have been 'coordinated' within available capacity in a simulation of the slot coordination process. The busy day in annualised by applying the 'busy day to annual' ratios and load factor assumptions, derived from the daa-provided Centreline case unconstrained busy day forecast schedules. The schedules adopt common annualisation factors, and airline fleet modernisation is a function of aircraft replacement cycles, so do not vary with constraint scenario.

Appendix A: Annual Passenger and ATM Tables

Annual Traffic – daa Input Forecasts

Centreline case used for busy day forecast schedule analysis

Annual Passengers (m)

DUBF20-01 Passengers (mppa)			
Year	Centreline	Low	High
2011	18.7	18.7	18.7
2012	19.1	19.1	19.1
2013	20.2	20.2	20.2
2014	21.7	21.7	21.7
2015	25.0	25.0	25.0
2016	27.9	27.9	27.9
2017	29.6	29.6	29.6
2018	31.5	31.5	31.5
2019	32.9	32.9	32.9
2020	7.4	7.4	7.4
2021	7.9	6.0	10.0
2022	21.0	14.0	26.3
2023	26.7	21.0	32.0
2024	31.2	25.7	34.4
2025	32.3	27.7	37.6
2026	34.0	28.8	38.7
2027	35.6	29.8	39.9
2028	37.0	30.7	41.1
2029	38.4	31.6	42.4
2030	39.6	32.5	43.7
2031	40.5	33.3	44.7
2032	41.3	34.1	45.7
2033	42.1	34.9	46.7
2034	42.7	35.6	47.6
2035	43.4	36.3	48.4
2036	44.0	37.0	49.3
2037	44.7	37.7	50.1
2038	45.3	38.4	50.9
2039	46.0	39.1	51.6
2040	46.6	39.8	52.3
2041	47.2	40.3	53.0
2042	47.8	40.8	53.7
2043	48.4	41.3	54.4
2044	49.0	41.8	55.0
2045	49.5	42.4	55.7
2046	50.1	42.9	56.4
2047	50.7	43.3	57.0
2048	51.2	43.8	57.7
2049	51.8	44.3	58.3
2050	52.3	44.7	58.9

Annual ATMs (000s)

DUBF20-01 Movements (000's)			
Year	Centreline	Low	High
2011	162	162	162
2012	164	164	164
2013	170	170	170
2014	180	180	180
2015	198	198	198
2016	215	215	215
2017	223	223	223
2018	233	233	233
2019	239	239	248
2020	93	91	95
2021	133	112	182
2022	176	143	205
2023	208	176	238
2024	232	208	251
2025	240	213	265
2026	249	219	271
2027	256	224	278
2028	263	230	285
2029	270	236	293
2030	276	242	300
2031	282	246	306
2032	286	250	313
2033	291	253	318
2034	295	257	324
2035	299	260	330
2036	302	264	335
2037	306	267	340
2038	310	270	345
2039	314	273	349
2040	318	277	354
2041	322	280	358
2042	325	283	362
2043	329	286	366
2044	333	289	370
2045	336	292	375
2046	340	295	379
2047	344	298	383
2048	347	301	387
2049	350	304	390
2050	354	307	394

Source: daa

Annual Traffic Impact – Constrained Scenarios

Annual Passengers (m)

Scenarios	A	B	C	D	E	F
2015	25.0					
2016	27.9					
2017	29.6					
2018	31.5					
2019	32.9	32.9	32.9	32.9	32.9	32.9
2020	7.4	7.4	7.4	7.4	7.4	7.4
2021	7.9	7.9	7.9	7.9	7.9	7.9
2022	21.0	19.6	21.0	21.0	19.6	20.6
2023	26.7	24.9	26.7	26.7	24.9	26.2
2024	31.2	29.3	31.2	30.8	29.3	30.8
2025	32.3	30.4	32.3	32	30.4	31.9
2026	34.0	31.6	34.0	32	31.2	33.3
2027	35.6	32.8	35.6	32	32	34.7
2028	37.0	33.9	37.0	32	32	36.2
2029	38.4	35.1	38.4	32	32	37.6
2030	39.6	36.3	39.6	32	32	39.0
2031	40.5	37.0	40.5	32	32	39.7
2032	41.3	37.6	41.3	32	32	40.4
2033	42.1	38.2	42.1	32	32	41.0
2034	42.7	38.9	42.7	32	32	41.7
2035	43.4	39.5	43.4	32	32	42.4
2036	44.0	40.0	44.0	32	32	43.0
2037	44.7	40.5	44.7	32	32	43.6
2038	45.3	41.0	45.3	32	32	44.2
2039	46.0	41.5	46.0	32	32	44.7
2040	46.6	42.0	46.6	32	32	45.3
Traffic Impact						
2022-2025	-	-7.0	0.0	-0.7	-7.0	-1.7

Annual ATMs (000s)

Scenarios	A	B	C	D	E	
2015	198					
2016	215					
2017	223					
2018	233					
2019	239	239	239	239	239	239
2020	93	93	93	93	93	93
2021	133	133	133	133	133	133
2022	176	166	176	176	166	173
2023	208	195	208	208	195	204
2024	232	219	232	229	219	228
2025	240	227	240	236	227	237
2026	249	232	249	236	233	246
2027	256	238	256	236	236	253
2028	263	244	263	236	236	260
2029	270	249	270	236	236	267
2030	276	255	276	236	236	272
2031	282	259	282	236	236	278
2032	286	262	286	236	236	282
2033	291	266	291	236	236	286
2034	295	270	295	236	236	289
2035	299	273	299	236	236	292
2036	302	276	302	236	236	296
2037	306	279	306	236	236	300
2038	310	282	310	236	236	303
2039	314	285	314	236	236	307
2040	318	289	318	236	236	310
Traffic Impact						
2022-2025	-	-48	-	-6	-48	-13

Appendix B: EU Slot Regulation and Precedents Analysis

Executive summary

Introduction

- This in an annex to the report prepared by Mott MacDonald for daa entitled:
  - **Dublin Airport Operating Restrictions –** Quantification of Impacts on Future Growth (September 2020 Update – 2022-2025 Period) version 5.3
- daa is developing a new North Runway. Construction is due to be complete by the end of 2020, with commissioning occurring during 2021 and full operation by 2022. The runway's planning permission granted in 2007 contains 31 conditions. Condition 3d requires that that the new North Runway will not be used between the hours of 23:00-07:00 local time, and Condition 5 limits the number of 23:00-07:00 operations to 65/night on average when the new runway is complete.
- This annex benchmarks the proposed night restrictions for Dublin Airport (DUB) against comparable airports in Europe and worldwide, and explores the issues arising from implementation of the proposed night restrictions in ways compliant with the EU Slot Regulation.

EU Slot Regulation Summary

- The EU Slot Regulation governs the allocation of scarce capacity at airports. DUB is designated as a 'coordinated airport' under the EU Slot Regulation. This means that operators must be allocated a 'slot' to operate at the airport by an independent slot coordinator, within capacities declared by the Commission for Aviation Regulation following consultation with the airport's Coordination Committee.
- A key principle of the slot process is that airlines have 'historic rights' to slots, whereby they have a legal entitlement to slots allocated and operated at least 80% of the time in the previous equivalent season (the *use-it-or-lose-it* rule).
- In response to the COVID-19 pandemic and disruption to air services from March 2020, the European Commission and Parliament adopted an amendment to the EU Slot Regulation to waive the *use-it-or-lose-it* rules for the Summer 2020 season. This waiver was subsequently extended to the end of the Winter 2020/21 season. As a consequence, airlines retain their historic rights to slots (including night slots) at levels equivalent to their 2019 slot use.
- The 65/night limit is significantly below the number of historic night slots held by airlines today and, therefore, infringes this entitlement.
- This study has assessed the night flying regimes of comparable European airports and found no precedents for the imposition of night limits requiring the allocation of scarce movements that affect airlines' historic rights. Examples from Amsterdam, Brussels Paris and London all show that night flying regimes have been designed to respect airlines' historic rights and introduce reductions in night flights gradually if demand falls.
- Therefore, in Mott MacDonald's view, it is unclear how the proposed DUB operating restrictions could be implemented in a way that is compatible with the EU Slot Regulation, given the lack of precedents at other EU airports, and that there are risks that an attempted implementation would be subject to potential legal challenge.

Night Restrictions Benchmarking

- The table below summarises night restrictions at a number of comparable European airports.
- Night restrictions are applied in accordance with EU Regulations on a case-by-case basis, based on local conditions and many airports have no night restrictions. The purpose of this analysis is to benchmark the proposed DUB night restrictions with comparable European airports to understand how night movements are managed elsewhere.
- It should be noted that at other airports, night limits have been set to accommodate historic demand and only reduced in ways that do not infringe airlines' historic rights to night slots.
- It should also be noted that the proposed night restrictions period at DUB from 2300 to 0700 (8 hours) is unusually long. Only Amsterdam and Warsaw have equivalent night restrictions periods. The average night restrictions period is between 6h and 6.5h.
- In particular, the London airports (DUB's closest competitors) have a night restrictions period from 23:30 to 06:00. This night restrictions period does not constrain first-wave departures (post 06:00), which feature heavily in DUB's night restrictions period demand, and allows unrestricted arrivals up to 23:30.

Airport		Night Period (local time)	No of Night Hours	Slot or Runway Time	Comments
London	LHR LGW STN	23:30 - 06:00	6.5h	Runway	Seasonal limits on movements and noise (Quota Count) points. Limits reviewed 5-yearly. Number of night flights has remained constant since the 1990s, but noise points have been reduced in line with introduction of quieter aircraft
Amsterdam	AMS	Arrivals 22:40-06:59 Departures 23:00-07:19	8h (approx)	Slot	Annual night movements limit currently 32,640/year reducing to 29,000/year.
Paris CDG	CDG	Arrivals 00:30 - 05:29 Departures 00:00 - 04:59	5h	Slot	Annual night movements limit set at 22,500/year in 2003/04 reducing progressively based on lost historics.
Frankfurt	FRA	23:00 - 05:00	6h	Runway	Curfew. Delayed arrivals permitted 23:00-23:59. Curfew introduced with opening of the new runway in 2011.
Munich	MUC	22:00 - 06:00 (restrictions) 23:30 – 05:00 (curfew)	8h 5.5h	Runway	Curfew 2330-0500 except postal and calibration flights. During shoulder period 2200-2330 and 0500-0600, limit on scheduled movements to 28/night except for quiet aircraft types.
Lisbon	LIS	Arrivals 00:05 - 06:00 Departures 23:55 - 05:50	6h	Slot	Night movement cap
Brussels	BRU	23:00 - 05:59	7h	Runway	Annual night movements limit. *Silent Nights:* no new slots allocated between 01:00-06:00 Saturdays and 00:00-06:00 Sundays/Mondays.
Zurich	ZRH	Arrivals 00:00 - 05:00 Departures 00:00 - 06:00	Arrivals – 5h Departures – 6h	Runway	Curfew
Vienna	VIE	23:30 - 05:30	6h	Runway	Night movement cap
Warsaw	WAW	22:00 - 06:00	8h	Runway	Night noise point limit

EU Slot Regulation

Slot Coordination

- Where demand for air services at an airport exceeds capacity, a process of *schedule facilitation* or *slot coordination* may be applied to manage airline schedules and the operations of other aircraft operators within available capacity. These processes are governed by the EU Slot Regulation(1).
- At a *schedules facilitated* airport, schedule time adjustments are negotiated with airlines on a voluntary basis. Where there is a significant shortfall in capacity and such voluntary processes are ineffective, the airport may be designated as *coordinated*, and a process of slot coordination implemented. At a *coordinated* airport, airlines must have a *slot* allocated prior to operation, and must adhere to the allocated slot time. Financial penalties are in place for intentional slot misuse (e.g., operating without a slot or intentionally operating at the wrong time). Slots are allocated by an *airport coordinator*.
- The Member State is responsible for designating an airport as *coordinated* and ensuring that an independent coordinator is appointed. In Ireland, these responsibilities are performed by the Commission for Aviation Regulation (CAR). The CAR's roles are:
  - to designate Community airports located in Ireland as schedules facilitated or coordinated as appropriate,
  - to appoint a schedules facilitator or coordinator as necessary,
  - to approve any local guidelines proposed by the airport's Coordination Committee
  - the seasonal declaration of slot coordination parameters.
- The CAR designated Dublin Airport as a *coordinated* airport with effect from March 2007, and appointed Airport Coordination Limited as the airport's coordinator.
- The EU Slot Regulation also requires Member States to ensure that at a coordinated airport:
  - A *Coordination Committee* is set up to advise on matters relating to airport capacity and slot allocation *(Article 5); and*
  - That the airport's coordination parameters (capacities) are determined each season (*Article 6*).

(1) Council Regulation (EEC) No 95/93 on common rules for the allocation of slots at Community airports, as amended by Regulation (EC) No 793/2004

- Dublin Airport has a Coordination Committee, with membership consisting of daa as the airport operator, IAA as the ATC provider, and the airlines operating regularly at the airport.
- The CAR is responsible for the determination of coordination parameters under Article 6 of the EU Regulation following consultation at the airport's Coordination Committee.
- The Coordination Committee also has the ability, under the EU Regulation, to develop local guidelines relating to the allocation of slots. DUB currently has two local guidelines(2). The London airports have guidelines relating to the allocation of night movements and noise quota, for example. All local guidelines must be approved by the Member State (the CAR in Ireland) and must be in compliance with Community law (ie, they cannot override an explicit provision of the EU Regulation).
- daa, as the airport operator, has 4% of the voting rights on the Coordination Committee. Over 90% of the votes are controlled by airlines (in proportion to their movements at the airport)(3). This means that daa does not control the process for declaring coordination parameters or setting local guidelines on the administration of operating restrictions at the airport.
- The roles and responsibilities under the EU Regulation, as applied in Ireland, are summarised below:

Role	Responsible Body
Airport designation	CAR
Appointment of coordinator	CAR
Allocation of slots	Coordinator
Determination of coordination parameters	CAR
Development of local guidelines	Coordination Committee + CAR approval

(2) *Local Guideline 1: Urgent and Time Critical Operations; Local Rule A (to manage Covid-19 related capacity reductions)*
(3) Dublin Airport Coordination Committee Constitution

EU Slot Regulation

Historic Right to Slots

- Article 10(2) of the EU Slot Regulation grants airlines *'historic rights'* to series of slots, where a *series of slots* is at least 5 operations at the same time on the same day-or-week in a season (e.g., a series 06:30 departure slots on at least 5 consecutive Tuesdays in a summer season). This means that historic rights apply only to regularly scheduled services, and not to ad hoc operations such as a one-off positioning flight or GA operation.
- Historic rights are subject to a *use-it-or-lose-it* rule, whereby the airline must operate at least 80% of the slots in the series to retain the slots in future seasons (e.g., operate 4 of the 5 Tuesday 06:30 departures in the example above). Except for this *use-it-or-lose-it* rule, there is no mechanism under the EU Slot Regulation to withdraw airlines' historic slots.
- Dublin Airport's currently-established schedule (as at Summer 2019) has more slots to which *'historic rights'* apply within the 23:00-07:00 period than the 65/night permitted under the planning condition – there were 113 regularly scheduled commercial night flights in the Summer 2019 busy day analysed for this study.
- In response to the COVID-19 pandemic and disruption to air services from March 2020, the European Commission and Parliament adopted an amendment to the EU Slot Regulation to waive the *use-it-or-lose-it* rules for the Summer 2020 season. This waiver was subsequently extended to the end of the Winter 2020/21 season. As a consequence, airlines retain their historic rights to slots (including night slots) at levels equivalent to their 2019 slot use.
- Therefore, there is an issue of how the 65/night movement limit could be implemented under the EU Slot Regulation. This study has examined case studies and precedents applied at other European airports.

DUB Night Restrictions and the Slot Regulation

- The key characteristics of the Dublin night restrictions from a Slot Regulation point of view are:
  - That the limits are below historic levels of night flying and compliance would impact on airlines' historic rights;
  - The restrictions are not temporary; and
  - The restrictions are not a curfew, where the airport is effectively closed, but a limited number of movements which must be allocated to airlines according to some mechanism deemed to be fair and reasonable.
- The case studies for the European airports examined are discussed on the following pages.

EU Slot Regulation

Case Study – Frankfurt Airport

- Frankfurt Airport opened a new runway in late October 2011. On 11 October 2011, the Hessian Administration Court ruled that night flights between 23:00 and 05:00 were no longer allowed at Frankfurt Airport after the inauguration of the new runway, and therefore over-rode an approval from the Hessian government from 2007 which allowed 17 scheduled flights per night. On 4 April 2012 the German Administrative Court confirmed the decision of the Hessian Administration Court, banning night flights between 23:00 and 05:00.
- As the ruling imposed a curfew on the airport, it was deemed that airlines' historic rights to night slots were void. The curfew applied to all flights, so there were no issues of having to allocate a scarce resource, and applied to all types of flight.
- Before the curfew was introduced, night operations were primarily cargo services, with Lufthansa being the largest operator. The affected night flights were rescheduled out of the curfew period with priority given to these mandatory time changes in the slot coordination process.

Case Study – Brussels Airport

- In 2009, the Belgian authorities introduced a *Silent Nights* policy, applying to the 3 weekend nights (Friday through Monday). It is not a curfew, but restrictions prohibiting the allocation of <u>new</u> slots during the Silent Night periods. Historic night flights are permitted to continue to operate.

Case Study – Paris CDG

- In November 2003, effective from the Winter 2003/04 scheduling season, the French authorities implemented an annual limit on night flights at Paris CDG. The restrictions apply between 00:00 and 04:59 for departure slots and between 00:30 and 05:29 for arrival slots. The limit was set in 2003 at 22,500 night slots measured over a 52 week period for the Winter 2003/04 and Summer 2004 season. This level was set to accommodate current levels of demand at that time.
- For subsequent years, the limit of 22,500 is reduced if airlines fail to retain historic rights to night slots or return them voluntarily. Such slots are permanently lost and not reallocated to other airlines.
- The order implementing the Paris CDG night restrictions specifically refers to compatibility with the EU Slot Regulation. The mechanism to reduce available night slots only as and when slots are lost under the usage rule is designed to avoid conflicting with airlines' historic rights while progressively reducing night flying.

EU Slot Regulation

Case Study – London Airports

- The 3 main London airports (Heathrow, Gatwick and Stansted) are subject to night flying restrictions between the hours of 23:30-06:00, applied by the UK Department for Transport (DfT). The restrictions set seasonal limits on both the number of night movements and on the number of *Quota Count* (QC) noise points. Each aircraft is assigned a QC rating based on its noise certification and there is a limit on the total number of QC points operated each season.
- The London night restrictions are set for 5-year periods, and the DfT consults widely on changes in the limits in advance of each new quinquennium. The number of night movements available has remained the same at each airport since 1999, but there have been reductions in the QC limits.
- The reductions in QC limits were applied progressively and followed analysis and consultation to ensure that they remained adequate for continued airline operations while at the same time bearing down gradually on aircraft noise, so incentivising airlines to invest in quieter aircraft.
- This progressive approach in line with airline fleet modernisation has ensured that airline historic rights to night slots has not been affected.

Case Study – Amsterdam Schiphol

- In 2013 the number of historic night slots at Amsterdam Schiphol airport was 34,620 per annum. There is a policy objective to bring this down to 29,000 over a number of years. In order to do this, when airlines fail to retain historic rights to night slots or return them voluntarily, such slots are not re-allocated on a basis eligible for historic rights. Instead, spare night slots may be only used by airlines on a non-historic basis.
- This process is intended to gradually reduce the number of night slots eligible for historic rights so that the movement limit may be reduced in future. Airlines allocated non-historic night slots understand that such slots are only available temporarily.

Case Study – Warsaw Chopin Airport

- Warsaw Chopin airport had night restrictions of 40/night. Demand had grown above this level and, in 2012, slot coordination was introduced to reduce demand within the limit and control night flying going forward.
- Prior to this point, Warsaw Chopin had not been designated as *coordinated* and airlines did not have historic rights to slots (which only exist at a coordinated airport). Therefore, airlines did not have a legal basis to challenge the imposed reduction in night flights.
- In establishing slot coordination for the first time, airlines were required to adjust their schedules to fit within the night restriction. The process was administered by Airport Coordination Limited, who also act as the coordinator of Dublin Airport.
- The coordination process adjusted the timings of flights by the minimum amount necessary to reduce demand (i.e., moving flights from the edge of the night restrictions period), and in a proportionate way amongst airline operators.
- Subsequently, the night movement restriction at Warsaw Chopin was replaced by a Noise Point limit modelled on the London QC system. The effect of this change was to allow approximately 20% more night flights within the same noise contour profile, made possible by the introduction of quieter aircraft at the airport.

EU Slot Regulation

Case Study – Temporary Demand Reductions

- Dubai International (DXB) and Brussels airports underwent major runway resurfacing projects in 2014 and 2015 respectively. As a result of these works, there were significant reductions in runway capacity for a temporary period meaning that reductions in the flight schedules were required.
- In both cases, airlines were required to make pro rata reductions in their schedules, with exemptions for airlines which only operated 1 or 2 flights per day. The effect of these exemptions was that the larger airlines were required to make reductions above the airport average. This was deemed to be the fairest way to 'share the pain'.
- In both cases, there was a waiver of the *use-it-or-lose-it* rule during the works so that airlines' historic rights to slots were protected and flights could resume after the works were complete and capacity returned to normal.
- There is no process under the EU Slot Regulation or IATA Worldwide Slot Guidelines (which cover slot allocation rules worldwide, but do not have the force of law) to cater for such demand reductions. The demand reduction processes were developed specifically for these capacity reduction scenarios, but were none-the-less accepted by the industry on the basis that the works were necessary, the reductions were temporary, and the alternative to planned schedule reductions would have been unacceptable levels of flight delay and disruption.
- Although these cases do not relate to night movements, they provide a guide on possible ways to reduce demand in a fair way.

EU Slot Regulation

Conclusions on EU Slot Regulation Assessment

- The conclusions from these case studies, which relate to Dublin's night restrictions, are:
  - Except in the case of the Frankfurt Airport night curfew, reductions in night movements have only occurred as demand for night flying naturally fell or where airlines have lost historic slots through non-use. The principle of historic rights has been respected.
  - However, the Frankfurt curfew case is not comparable to the Dublin situation as it involved a complete night ban, not limits on night flying creating a scarce resource with the consequent allocation and distribution issues.
  - Where demand reductions have been implemented, the approach of requiring pro rata reductions with exemptions for small operators has been adopted. This has only been applied in the case of temporary reductions (eg, Brussels and Dubai airports), however.
- The 65/night limit proposed for Dublin presents a difficult issue of how current levels of night flying can be reduced. Such reductions are in conflict with the EU Slot Regulation, appear to be without precedent, and are likely to be open to legal challenge.
- daa is not in control of the capacity declaration process, responsibility for which resides with the CAR. Therefore, the ability of daa to declare night restriction limits, particularly without the support of the Coordination Committee and the CAR, is untested. Local rules relating to night slot allocation are subject to agreement by the Coordination Committee and approval by the CAR.
- The majority (over 90%) of votes on the DUB Coordination Committee are held by the airlines who would have their historic rights to night slots impacted by the restrictions.

Assumptions for this Study

- For the purposes of this study, a pro rata reduction in night flying has been assumed, described in the next section.
- These assumptions are made for the purposes of the subsequent analyses. Whether such rules could be introduced and applied in practice is open to challenge, for the reasons discussed above.

Appendix C: Independent Review of daa Forecasts

Forecast Review Contents

Summary

Introduction

- Mott MacDonald has been appointed by daa to provide an independent review of the unconstrained traffic forecasts through 2050 and forecast flight schedules. This report considers daa's normal forecasting methodology, as applied for pre Covid-19 pandemic projections, and the latest traffic recovery forecasts reflecting the Covid-19 crisis.
- This review is conducted in parallel with the development of constrained busy day schedules and analysis of the current Dublin Airport operational restrictions which limit use of the new North Runway at night and the number of night movements. This report focuses on the independent review of the unconstrained traffic forecast, for both pre and post Covid-19 crisis scenarios.
- We have reviewed the long term traffic forecasts produced by daa to determine the extent to which the forecast outputs represent a fair and reasonable expectation of the likely development of passenger traffic and aircraft movements over the forecast period (to 2050).
- The review examines the latest Post Covid-19 recovery scenarios (developed October 2020) and the normal long-term forecast methodology based on Pre Covid-19 forecasts (developed July 2019).
- Our review focused on the methodology, inputs, and assumptions adopted by daa in preparing the forecasts. We also reviewed the reasonableness of the traffic forecasts themselves (both pre and post Covid)
- The forecasts have drawn upon a wide variety of input sources such as data provided by daa, data collated by Beontra's internal databases and reputable industry-wide data.
- daa has prepared three traffic cases: Base, Low Case and High Growth Case. The forecasts are based on a number of key assumptions which we have reviewed and commented upon under Section C3.

Main Observations and Conclusions

- The daa long term traffic forecasts are based on a robust econometric forecasting methodology, using the Beontra strategic forecasting tool based on top-down macroeconomic-driven traffic forecast projections.
- The long-term forecast is mainly driven by top down macroeconomic growth projections (e.g. GDP, CPI) derived from reputable sources.
- daa develops its own bottom-up airline capacity traffic forecast upon which the long-term market growth projections from the top down Beontra model are placed.
- The bottom-up assumptions of the forecast are related to airline capacity development and introduction of new routes and airlines based upon the airport's market intelligence.
- daa's short term approach, informed by airline business intelligence and airport / airline market insight provides a sound starting point to the long term passenger and ATM growth projections.
- The market segmentation undertaken by daa is sensible, and the projected growth for all the market segments analysed appears to be reasonable in all cases.
- The Low and High case forecasts analyse the effects of slower or more rapid economic growth across the markets than the Centreline case, as well as lower or higher shares of hubbing transfer traffic. These cases follow commonly-recognised approaches to evaluating a range of traffic throughput outcomes that are reasonably likely to be realised.
- The Post Covid recovery scenarios model the short/medium term recovery profiles from the current crisis. The daa scenarios provide a reasonable Low-to-High recovery range given the inherent uncertainties. Daa's forecasts benchmark well with Eurocontrol and ACI international benchmarks.
- We have made in this report a number of recommendations and suggestions for further development of the forecasting methodology, which are largely technical in nature.
- Overall, the daa traffic forecasting methodology is robust and forms a valid basis for planning airport developments.

Contents

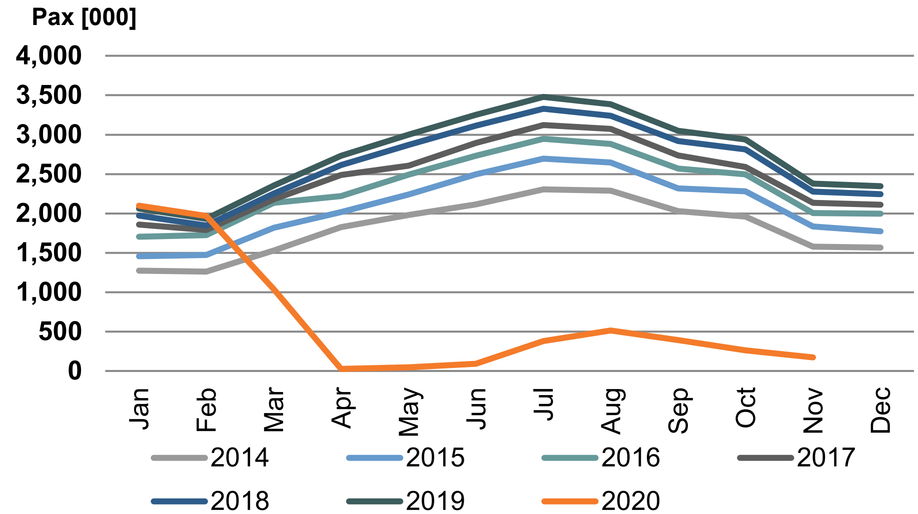
- In this section we present the impacts of the Covid-19 pandemic and air travel traffic crisis, as well as daa's latest (October 2020) recovery forecasts, including:
  - Covid-19 cases and deaths
  - 2020 traffic profiles
  - 2020-2050 recovery and forecast scenarios for passengers and ATMs
  - Impact on load factors and passengers-per-ATM
  - Recovery profile benchmarking

Dublin airport Covid-19 pandemic impact

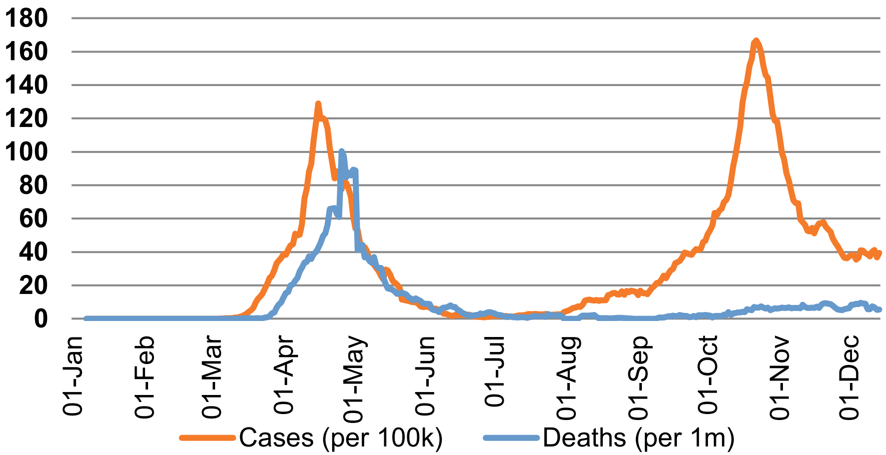
DUB Airport traffic came to a virtual standstill in April 2020 due to lockdown restrictions implemented to control the Covid-19 pandemic. After a tentative start to recovery in Q3 (July-Sept), traffic has slowed due to second-wave infections and the start of the winter season.

- DUB began 2020 with modest (~2%) traffic growth over 2019 levels in January and February, before the spread of Covid-19 globally brought air travel to a virtual standstill.
- Lockdown restrictions were imposed across Europe during March 2020, and DUB traffic during 2020 Q2 (April-June) was down 98% compared with 2019 levels.
- Ireland has experienced distinct waves of Covid-19 infections, the first occurring in April/May and a second in October/November. This two-wave pattern is typical of western European countries.
- DUB traffic started to recover slightly in Q3 (July-Sept) as infections subsided and lockdown restrictions were eased, but only reached 15% of normal levels in August before the second wave began. By November 2020, passenger traffic was again down 92% compared with 2019 levels.

Monthly distribution of passengers at DUB

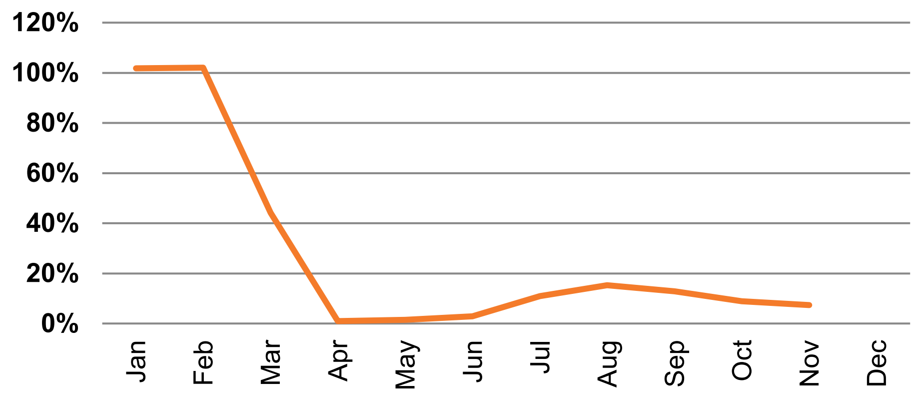


Ireland 7-day Covid-19 Cases and Deaths per Population



Source: European Centre for Disease Control

DUB 2020 Passengers as percentage of 2019



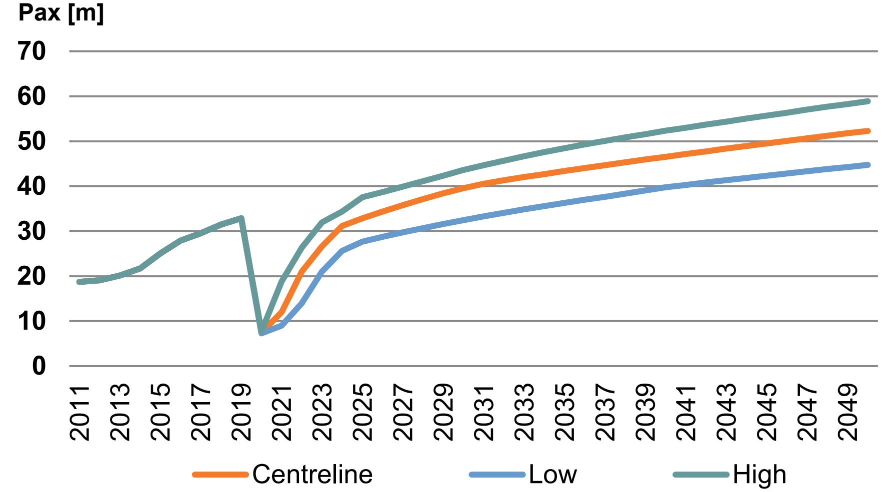
Source: daa

Dublin airport Covid-19 recovery

daa have produced post Covid-19 traffic recovery scenarios which expect recovery to 2019 traffic levels by around 2025. There is considerable uncertainty around traffic recovery from this crisis, which daa has addressed through appropriate Low and High case scenarios.

- The daa Covid-19 recovery scenario forecasts we are reviewing for this study were produced in October 2020. There remains considerable uncertainty regarding how the Covid-19 pandemic will progress, what infection control interventions will be required, and the consequent impact on air travel.
- Current projections are that 2020 full-year traffic will be around 7.5m passengers, equivalent to 23% of 2019 levels.
- The daa Centreline forecast scenario assumes that GDP recovers from the current recession to 2019 levels by 2021/22, but that the airport's passenger traffic will not recover to 2019 levels of around 32m annual passengers until 2025.
- Recovery exceeds 2019 levels by 2024 in the High case and 2030/31 in the Low case.

daa Revised Traffic Forecast (Oct 2020)

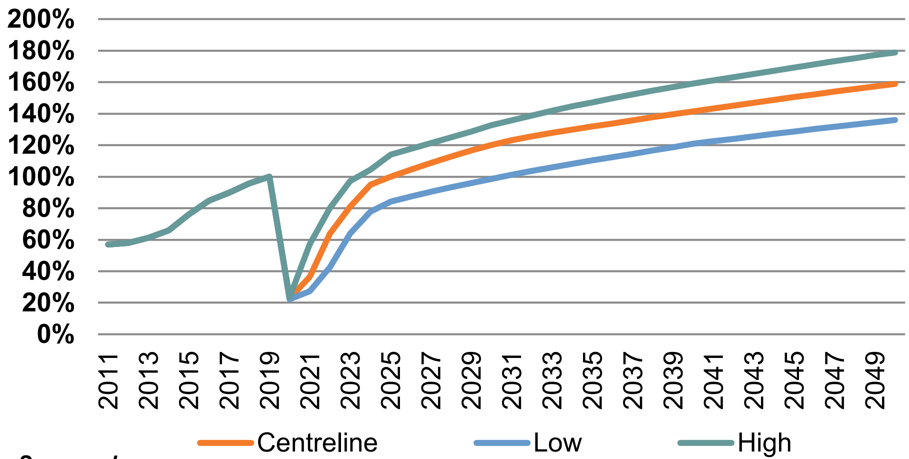


daa Revised Traffic Forecast (Oct 2020) – Pax(m)

Year	Centreline	Low	High
2019	32.9	32.9	32.9
2020	7.5	7.3	7.7
2021	12.0	9.0	18.8
2022	21.0	14.0	26.3
2023	26.7	21.0	32.0
2024	31.2	25.7	34.4
2025	32.3	27.7	37.6
2026	34.0	28.8	38.7
2027	35.6	29.8	39.9
2028	37.0	30.7	41.1
2029	38.4	31.6	42.4
2030	39.6	32.5	43.7
2031	40.5	33.3	44.7
2032	41.3	34.1	45.7
2033	42.1	34.9	46.7
2034	42.7	35.6	47.6
2035	43.4	36.3	48.4

Source: daa

daa Revised Traffic Forecast (Indexed 2019 = 100%)



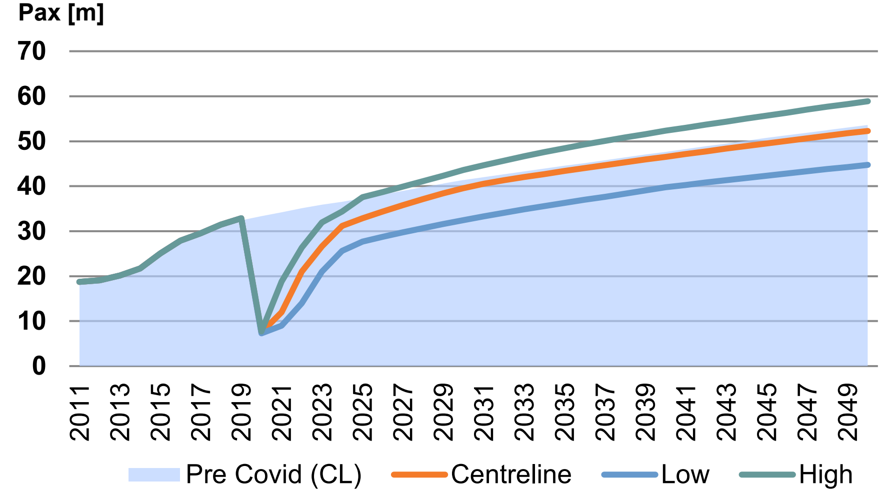
Source: daa

Dublin airport Covid-19 recovery assumptions

daa's post Covid-19 traffic recovery scenarios are reasonable and prudent given the current uncertainties regarding traffic recovery profiles.

- The 2020 full year estimate is 7.3 to 7.7 million passengers, based on year-to-date traffic performance (to September 2020) and projections for Q4 informed by airline published schedules and plans.
- 2021 scenarios are based on indications of airline recovery plans, the economic impact of the pandemic and GDP forecasts (sourced primarily from the IMF), and scenarios for control of the pandemic (infection rates, vaccine availability, etc) and the easing of travel restrictions. Given the uncertainties for 2021, the daa forecasts cover a wide range between 14 – 26m passengers (21m in the Centreline case).
- Post 2021, the forecasts follow Centreline/Low/High scenario trajectories towards recovery to 2019 traffic levels, occurring in 2025 in the Centreline case; 2024 in the High case; and not until 2030/31 in the Low case.
- After initial recovery to 2019 traffic levels, the daa forecasts assume above-trend growth rates for approximately 5 years of gradual recovery towards the long-term traffic trend.
- Traffic levels do not fully recovery to pre Covid-19 projections however. For the Centreline case, traffic levels in the long term lag daa's pre-Covid forecasts by about 2 years – for example, the latest Centreline forecasts reach 40m passengers in 2030/31 compared with 2028/29 in pre-Covid projections.
- Overall, our view is that the methodology and assumptions adopted by daa in developing the latest post pandemic traffic forecasts are reasonable and prudent given the uncertainties around traffic recovery from this crisis.

daa Revised Traffic Forecast Comparison



daa Traffic Forecast – Average Annual Growth Rates

	Pre Covid	Post Covid		
Average Growth Rates	Centreline	Centreline	Low	High
2019 – 2025	2.4%	0.0%	-2.8%	2.2%
2025 – 2030	2.1%	3.8%	3.2%	3.1%
2030 – 2035	1.5%	1.9%	2.3%	2.1%
2035 – 2050	1.2%	1.3%	1.4%	1.3%

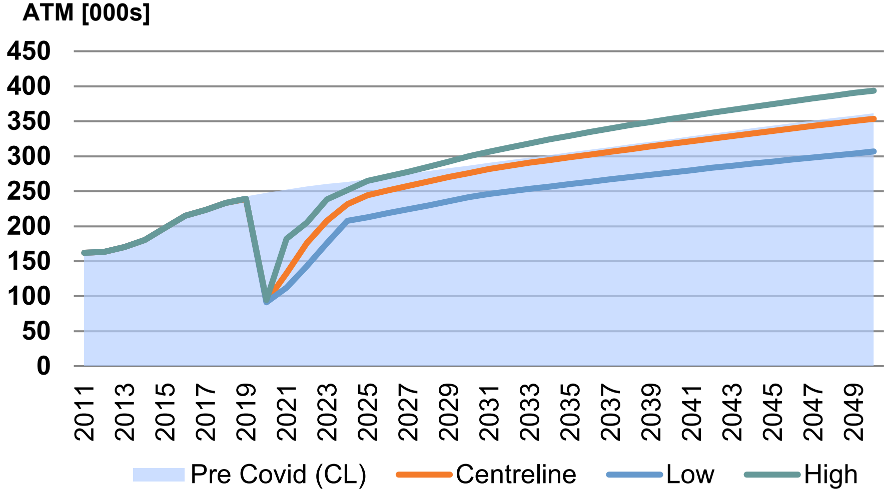
Source: daa

Dublin airport Covid-19 recovery – ATM forecasts

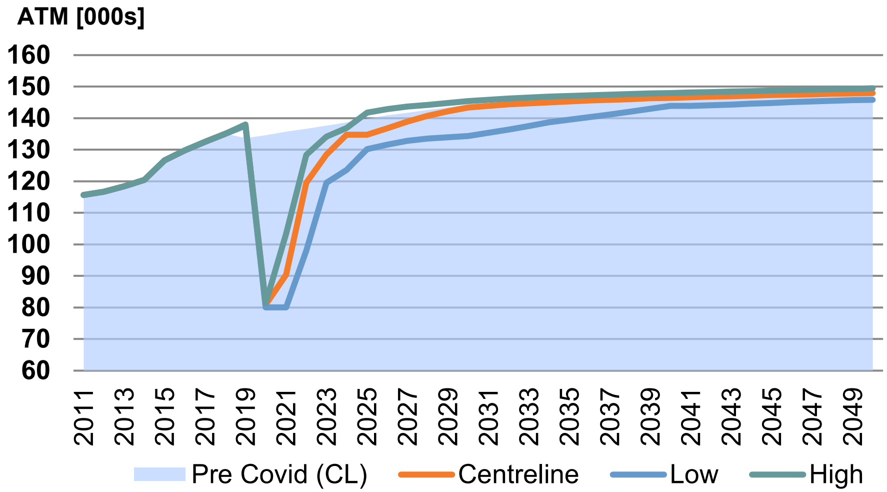
daa's post Covid-19 traffic recovery scenarios are reasonable and prudent given the current uncertainties regarding traffic recovery profiles.

- The charts opposite show the forecasts for air transport movements (ATMs) at DUB corresponding to the passenger traffic recovery scenarios discussed above.
- Overall, the number of ATMs has dropped less than the number of passengers. In 2020, ATMs are -62% down on 2019 levels, compared with -77% for passengers. This is due to a drop in the average passengers-per-ATM, resulting mainly from flights operating with low load factors but also due to airlines downsizing the aircraft type in operation.
- The daa forecasts expect load factors to remain low in 2021 before recovering towards pre pandemic levels, with a reasonable spread of recovery scenarios between the Centreline, Low and High cases.
- Normal slot use-it-or-lose-it rules were suspended for the Summer 2020 and Winter 2020/21 seasons due to the *force majeure* nature of the Covid-19 pandemic, allowing airlines to cancel flights without being at risk of losing historic rights to slots. For the Summer 2021 season, slot relief has been agreed in the EU, UK and other major regions, but there is an increasingly fragmented approach to relaxation of the slot usage rules, making airline planning and recovery more challenging.
- From 2022 onwards, it is reasonable to assume that airlines will be progressively required to use their slots in order to retain historic rights, although some relief from pandemic effects may still be required. As markets reopen, airlines will be under pressure to discount fares in order to achieve reasonable load factors and encourage passengers to fly again.
- Therefore, overall the daa scenarios for ATM and passengers/ATM recovery are reasonable and consistent with the passenger demand projections.

daa Air Transport Movement Forecasts



daa Average Passengers per ATM trends



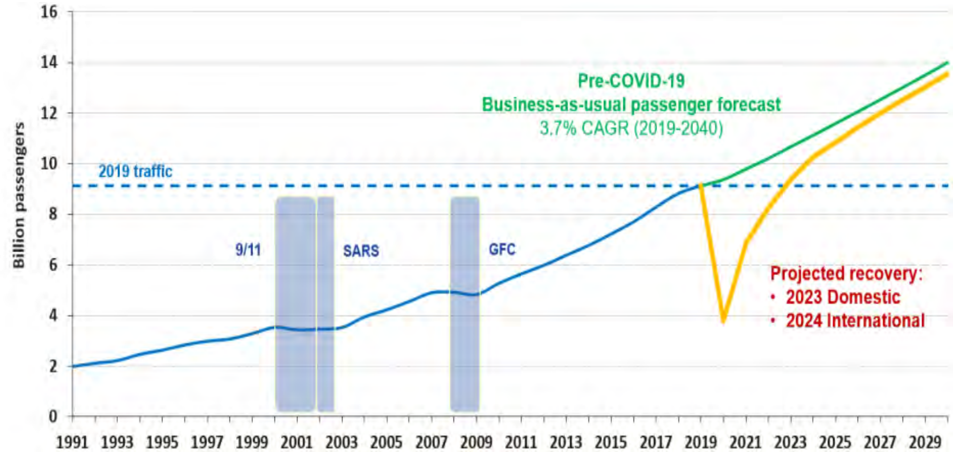
Source: daa

Dublin airport Covid-19 recovery – International Benchmarks

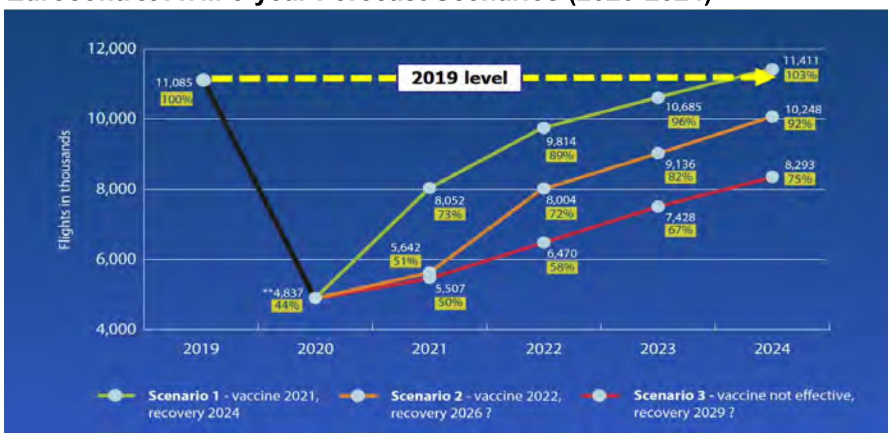
daa's post Covid-19 traffic recovery scenarios benchmark well with international comparators and appear reasonable.

- Comparing daa's recovery forecasts with other international benchmarks, we see broad consistency.
- **Eurocontrol's** latest forecasts for recovery of ATMs has recovery profiles for three scenarios based on vaccine roll-out and success. These show recovery to 2019 levels between 2024 – 2029. The daa forecasts show recovery to 2019 levels between 2024 – 2030 (High, Centreline, Low cases), which are broadly consistent with these Eurocontrol projections.
- The **Airport Council International (ACI)** global forecasts predict recovery to 2019 levels in the 2023 – 2025 period. This is 1-2 years' earlier than the daa forecasts, but the ACI forecasts represent global traffic. Faster than average recovery is expected in emerging markets and for domestic traffic (which is minimal in DUB). DUB competes in a mature aviation market and is dependent on international flights, so slightly slower traffic recovery than the global average is to be expected.
- Overall, the daa Covid-19 recovery forecasts benchmark well with international comparators and appear reasonable.

ACI Global Forecasts (2020-2030)

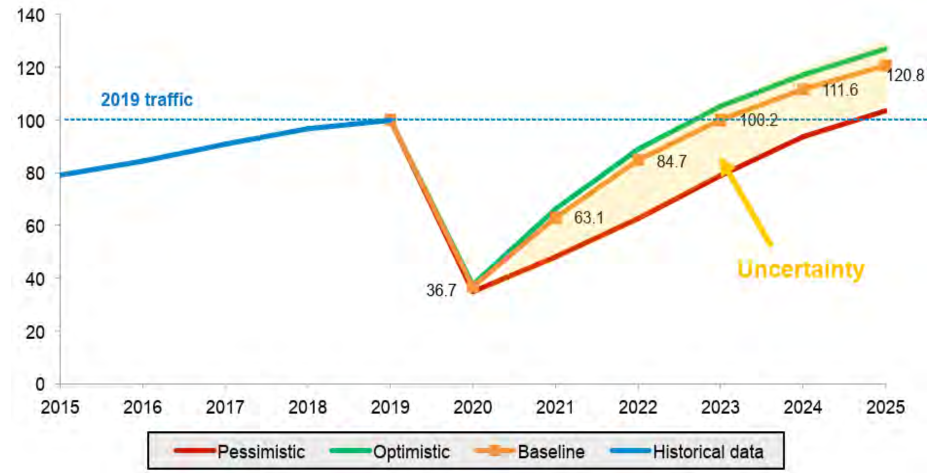


Eurocontrol ATM 5-year Forecast Scenarios (2020-2024)



Source: Eurocontrol (November 2020)

ACI Global Passenger Recovery Scenarios (2020-2025)



Source: ACI (8 December 2020)

Contents

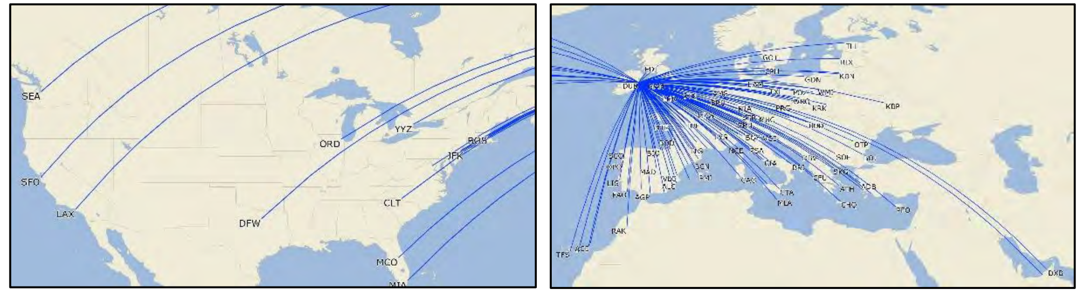
- A brief analysis of the Dublin market is presented in this section covering the following:
  - ➢Airline passenger performance
  - ➢Airline capacity overview
  - ➢Route network developments
  - ➢Traffic seasonality
  - ➢Historic fleet mix
  - ➢Recent market developments and trends

Airline route network review

Since the recovery from the 2009 Global Financial Crisis, DUB transfer volumes grew by 30% – x principally driven by Aer Lingus and partners connecting European and North American destinations

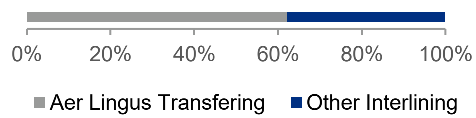
- DUB's geographical location makes it a natural gateway between North America and Europe and its U.S. border preclearance services make it an attractive connecting option.
- DUB handled around 2.2 million connecting passengers in 2019, and over 90% of these were transferring between North America and destinations in the UK and Europe.
- Aer Lingus represents over 60% of DUB connecting traffic, and if Aer Lingus Regional (operated by Stobart) is included, this share increases to around 70%.
- Ryanair and Aer Lingus provide over 70% of DUB's seat capacity. Both provide a comprehensive short haul network from DUB, while Aer Lingus also offers long-haul services to a number of North American destinations.
- Pre-Covid load factors at DUB range from 75% to 90% seasonally, with the highest levels coinciding with the busy summer months; overall, the average load factor is around 83%.

Scheduled route network from DUB for its top 5 operating carriers by ASMs for 2019



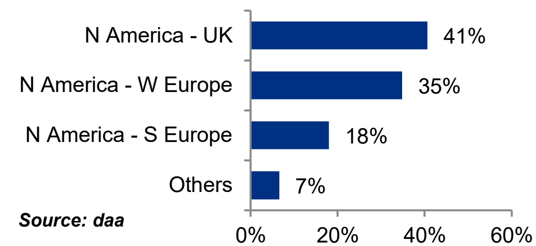
Source: SRS Analyser (full schedule for June 2019, top airlines in ASK for each region)

Aer Lingus share of connecting pax at Dublin Airport

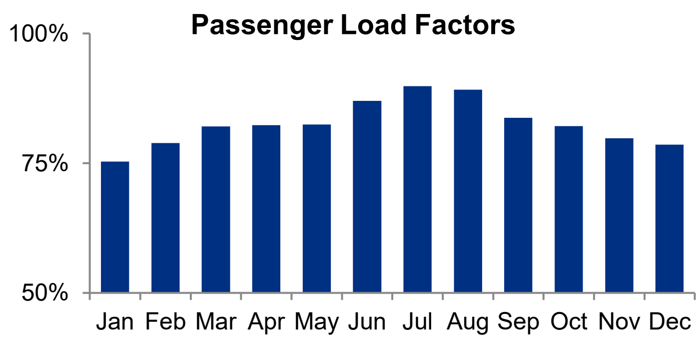


Source: MIDT

Dublin Airport transfer passenger flows

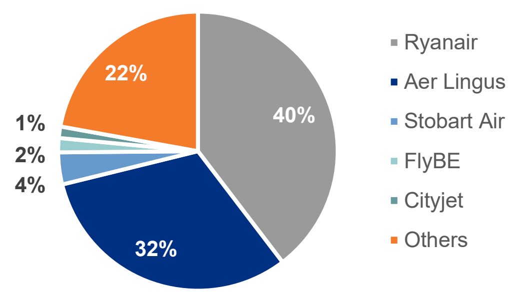


Source: daa



Source: daa

Dublin Airport top airlines scheduled capacity (seats) share for 2019



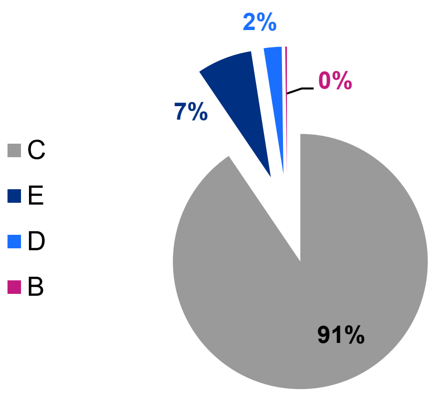
Source: SRS Analyser

Airline capacity review

Average seat capacity at DUB reflects a primarily ICAO Code C fleet operation from Ryanair and Aer Lingus; between them, these two carriers offer over 70% of the seats at DUB

- Aer Lingus and Ryanair, as DUB's main based carriers, is reflected in the overall airport average seat capacity, mirroring a primarily Code C operation from the two carriers for serving extensive short-haul networks.
- Pre-Covid, long-haul operations accounted for approximately 15% of total capacity offered out of DUB airport, covering the Transatlantic, African, Asian and Middle Eastern markets.
- It is likely that seat capacity will increase in future years. Ryanair, for example, will take delivery of Boeing 737 MAX 200s, configured with 197 seats (compared to 189 on the 737-800). There is also a potential increase in the DUB long-haul market share through further penetration in the transatlantic market from existing DUB carriers and the opening of new routes to Far East and South American destinations in the longer term.

Dublin Airport 2019 ICAO Code aircraft size distribution



Source: SRS Analyser

2019 market share & capacity summary table by main DUB operating carrier

Main DUB Carriers	ATMs	Seats	Seats/ATM
Ryanair	37.1%	40.5%	189
Aer Lingus Limited	27.0%	30.2%	194
Stobart Air	9.3%	3.9%	73
British Airways	2.4%	2.3%	166
Cityjet	2.2%	1.2%	94
DUB Overall	**229,546**	**39,682,525**	**171**

Source: SRS Analyser

2019 market share & capacity summary table by main DUB market segment

Main DUB Markets	ATMs	Seats	Seats/ATM
Western Europe	25.0%	24.2%	168
UK Provincial	20.7%	16.1%	134
Southern Europe	20.2%	21.7%	185
UK London	17.1%	16.1%	163
North America	8.0%	11.8%	256
Eastern Europe	5.2%	5.6%	184
Other Regions	2.5%	4.0%	280
Domestic	1.3%	0.4%	60

Source: SRS Analyser

Contents

- In this section we provide a summary overview of:
  - The daa long-term forecast approach
  - The daa annual traffic forecast results
  - The daa forecast schedules

Summary of daa long term forecasting approach

For the annual forecasts, daa uses a top-down macroeconomic approach driven Beontra forecasting tool to derive annual growth rate forecasts, applied to a 1-year bottom-up airline capacity modelling approach driven by airport / airline market intelligence.

Airline/airport capacity – Supply and demand side

Traffic Cases	Short Term (1-2 year)		Medium Term (~5 year)	Long Term (5 year +)	
Centreline case	• Full year actuals by market and passenger segments and schedules by carrier, route, a/c and month (Seats and ATMs) • 1-year bottom up forecast informed by airport & airline market intelligence on airline growth, services & capacity plans • Low case reflects lower load factors and fewer new services • High case reflects higher load factors and further new services	• Short term economic outlook for the country	• Macroeconomic forecasts: ❖ GDP/CPI [Sources: IMF WEO, OECD Economic Outlook] ❖ Population [Source: Eurostat] ❖ Beyond 5 years, daa apply a tail-off factor to replicate declining economic forecast trends	• Regression models for market growth based on: ❖ O&D economic forecasts ❖ Macroeconomic growth drivers ❖ Route maturities / historic performance ❖ Aggregated market regression outputs validated against: 1. Airbus, Boeing, ACI forecast estimates 2. Oxford Economics study 'Review of Future Capacity Needs at Ireland's State Airports', produced on behalf of the Department of Tourism, Transport and Sport (DTTaS)	• Continuation of the GDP growth rates at a decreasing rate
Low Growth case			• Macroeconomic downside: 1% decrease in Irish GDP for 10 years (to 2030) • Thereafter, GDP growth rates are equal to the Centreline case		• Continuation of the GDP growth rates at a decreasing rate
High Growth case			• Macroeconomic upside; 1% increase in Irish GDP growth rate for 10 years (to 2030) • Thereafter, GDP growth rates are equal to the Centreline case		• Continuation of the GDP growth rates at a decreasing rate

► The above graphic presents our understanding of the unconstrained long-term traffic forecast approach undertaken by daa.

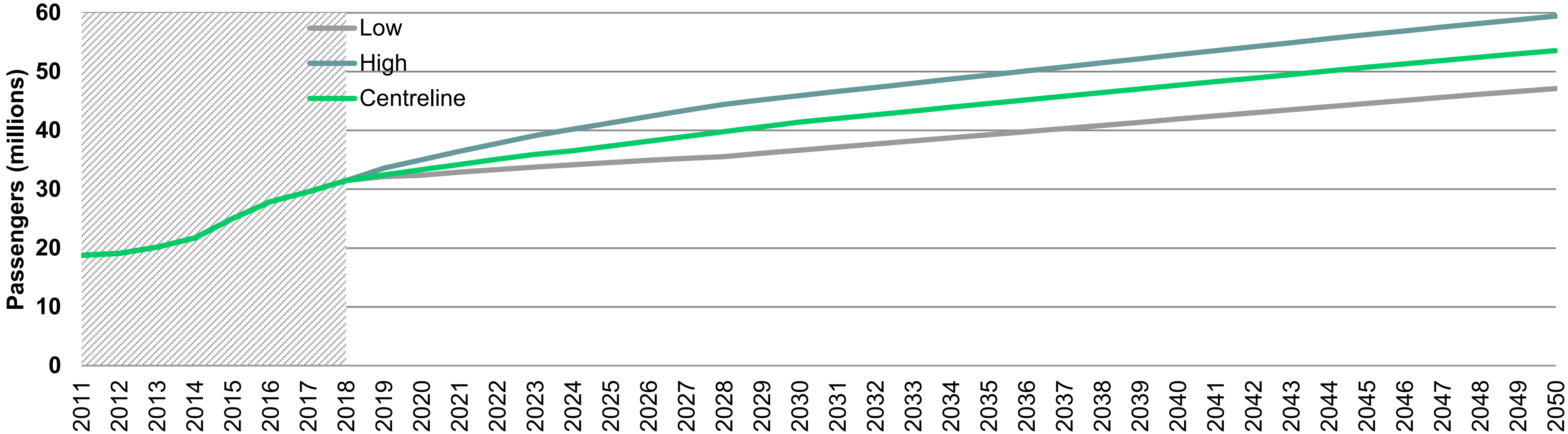
► The Beontra tool is the main mechanism used for the development of long-term annual forecasts, for the Centreline case. This tool is part of the Beontra Scenario Planning suite and allows the development of long-term forecasts using a set of econometric and statistical parameters.

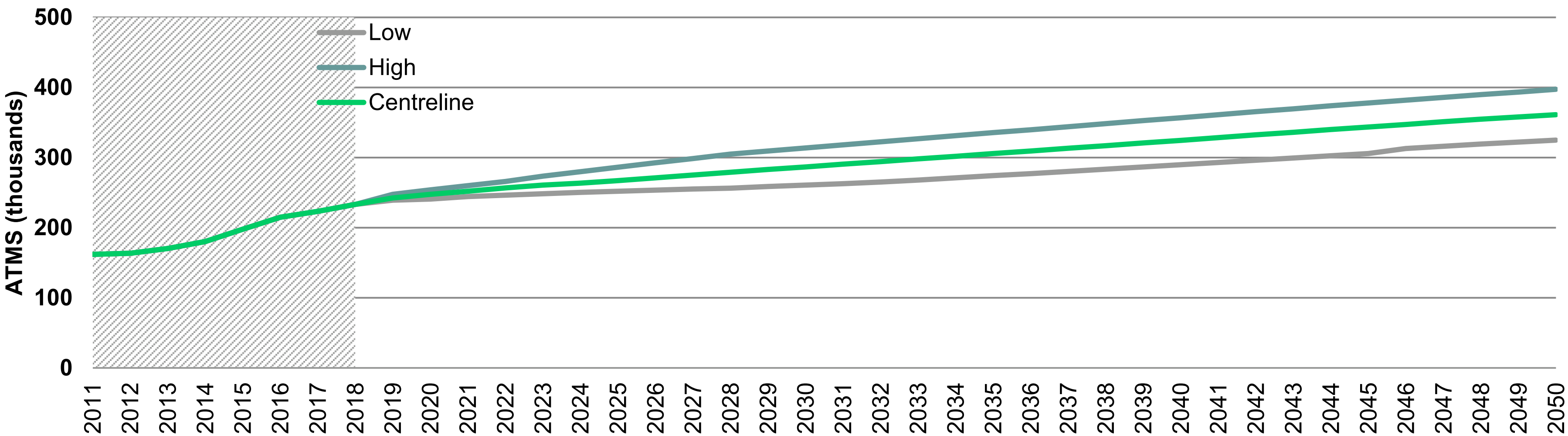
► A bottom up, airline capacities and market intelligence informed forecast is developed for Year 1 upon which the Beontra model growth rates by market are then overlaid to develop the long term centreline view.

► Publicly available macro-econometric forecasts as deployed as inputs to the Beontra model.

Summary of the daa annual traffic forecast outputs

The one-year bottom-up capacity driven forecast is combined with the Beontra econometric model output to derive annuals to 2050. These are the latest pre Covid long term forecasts developed in July 2019.





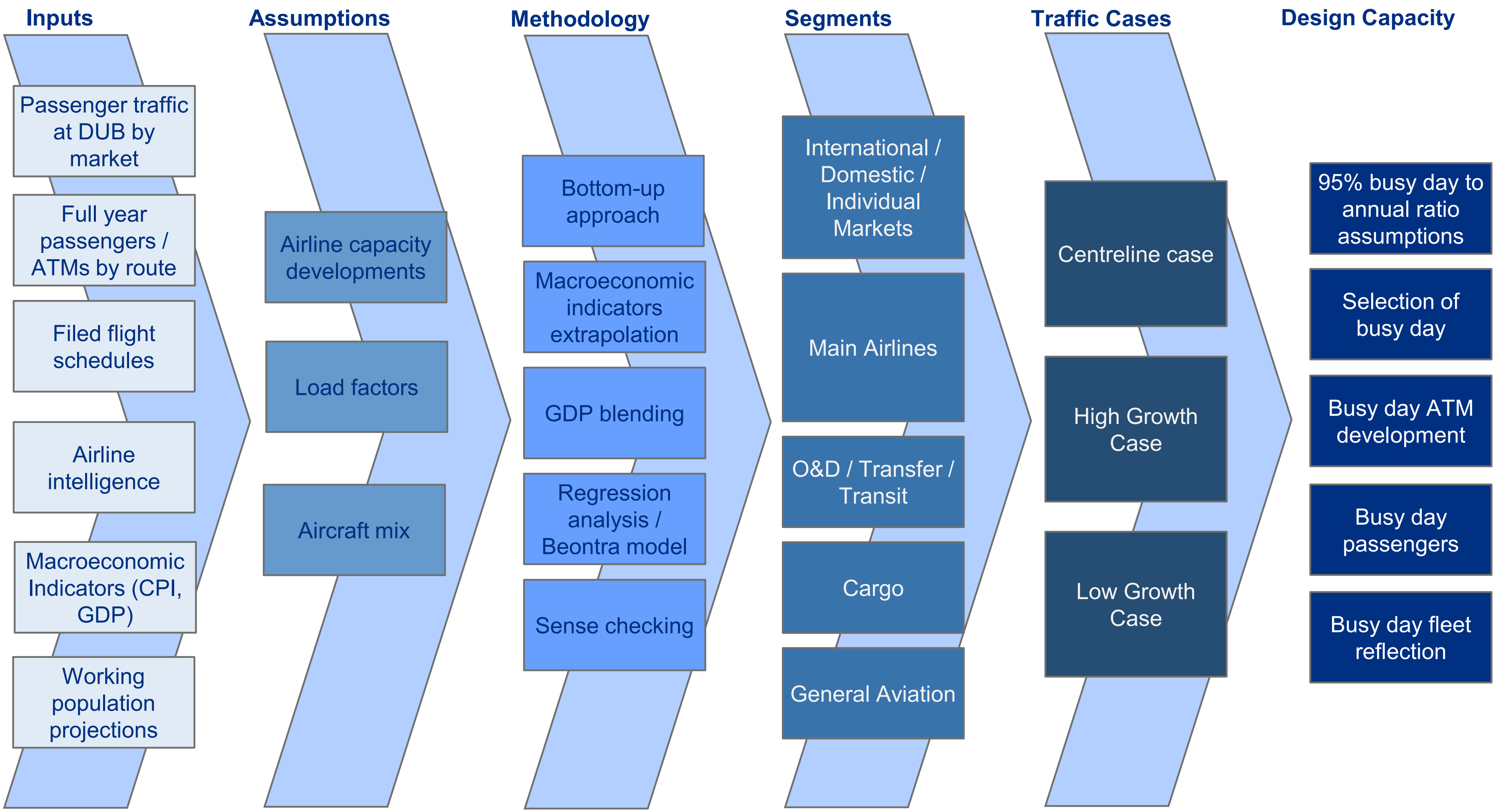
Source: Mott MacDonald analysis of daa data

Contents

- Our main review section covers:
  - Summary points of our traffic forecast review
  - The main forecasting inputs
  - The key assumptions and forecast drivers
  - The main methodology
  - The main traffic segments
  - The traffic forecast cases (Base, Low and High Growth)
  - The forecast schedule development methodology and outcome

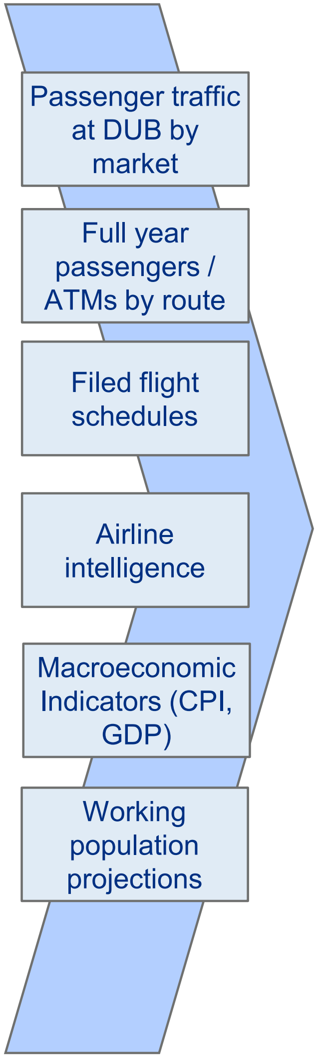
Our review – Summary

The headlines of our review on the daa traffic forecast are summarised on the figure below. The next pages include detail on the forecasting approach used by daa for each of the headline items, as well as our own review commentary highlighted in the blue boxes.



Our review – Inputs

We have reviewed the Pre Covid macroeconomic forecasts used by daa and we believe that they are a reasonable reflection of forecasts available.



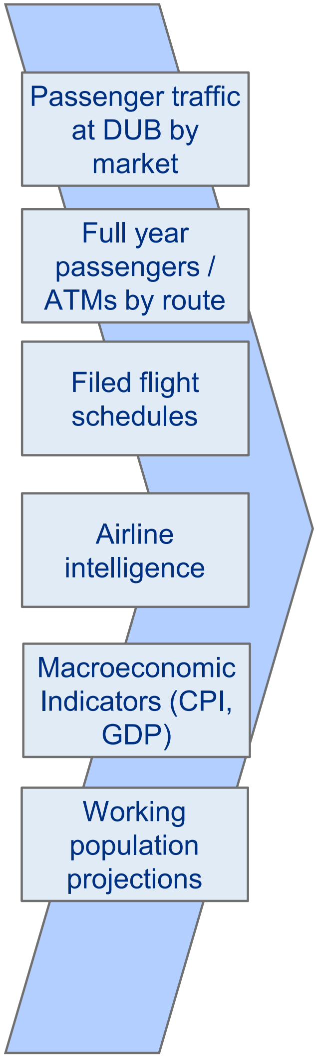
Commentary

- daa has used International Monetary Fund (IMF) World Economic Outlook Gross Domestic Product (GDP) projections to 2023 for the international markets and for the Irish domestic market.
- Post 2023, the daa has applied a decreasing trend to the GDP growth rates. This is similar to historic economic indicator trends that follow a gradual tailing-off profile in the later forecast years and also previous OECD GDP forecasts which also showed a tailing off in later years.
- For international markets, the Beontra model blends together the GDP forecasts for Ireland and the country in question to capture the different drivers of residents and non-residents. Inflation (Consumer Price Index, CPI, from IMF WEO) and working population (from Eurostat) are also used in some instances, depending on what combination of variables delivers the best correlation when predicting historic passenger performance.

- The macro-economic sources used in the daa model are commonly used in traffic forecasting.
- daa has used a reputable source for its GDP and inflation projections (the IMF) as well as a reputable source for its population projections (Eurostat) in order obtain a set of economic indicator projections for the entire forecast period.
- Undertaking multiple regression analysis and applying a blended GDP rate for the international markets is a prudent approach as it reflects both the inbound and outbound traffic, as well as close business and VFR ties between some of the countries.
- Beyond 2023, we would suggest using or benchmarking the growth projections against the OECD long term GDP forecasts until the end of the forecast period, for those markets that are available.
- We recommend that Irish overall population projections are used for the Domestic projections.
- The current economic situation in the UK is highly uncertain with 'Brexit' negotiations on-going.
- These forecasts represent the pre Covid situation. Post Covid forecasts should be updated as the pandemic and recovery profile develops.

Our review – Inputs

Latest available traffic and schedule data, as well as airline intelligence have provided a robust base for the one-year bottom up forecast.



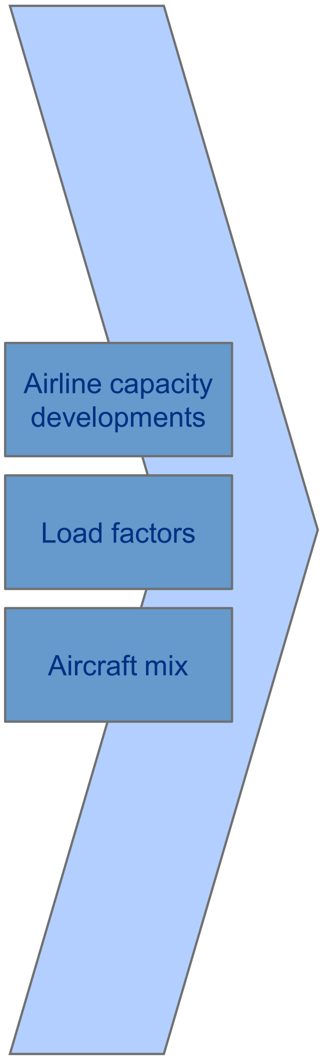
Commentary

- In the short-term (Year 1), daa normally uses a ‘bottom-up’ forecasting approach which considers the published flight schedule as its starting point, which is then overlaid with airline intelligence obtained mainly from its Aviation Business Development team.
- At the time the bottom-up forecast is produced (early in the year), daa has a good view as to the likely out-turn during Q1.
- Any adjustments made for the summer season can then be applied to the subsequent winter season.
- The bottom-up approach is used for one year only; a macro-economic approach is used thereafter.
- Due to the current Covid-19 crisis, the usual bottom-up approach was not used for the Post Covid traffic recovery scenarios, as there is too much uncertainty for this detailed approach to be appropriate.

- Traffic and flight schedule data are an industry wide common starting point for bottom up traffic forecasting, thus the daa approach is in line with industry standard practices.
- The market segmentation of the traffic forecasts reflects the key markets in which DUB is active.
- For an airport where charter flight operations comprise a small proportion of total (as is the case at DUB), using the most recent schedules to drive the bottom up process can lead to very accurate results.

Our review – Assumptions

There are no specific assumptions made for the long term forecasts, which are mainly driven by top down macroeconomic growth projections.

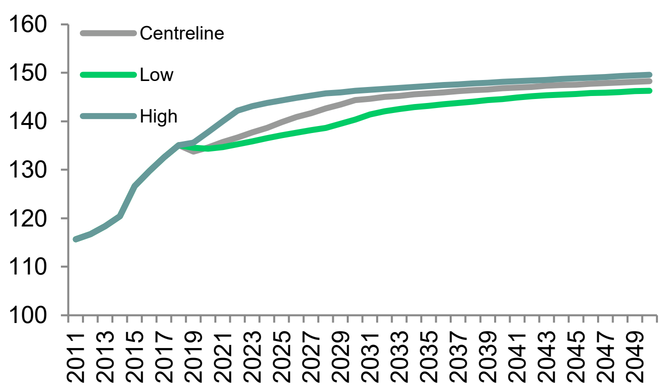


Commentary

- The bottom-up traffic estimates are driven by market intelligence assumptions such as short term monthly capacity development and new routes introduction by airlines for the short term, informed by the top-down growth primarily driven by GDP projections per country to provide the long-term traffic outlook.
- The high case passengers per ATM imply a continued trend towards larger aircraft along with load factor growth, whereas the low case passengers per ATM implies more moderate growth in both aircraft size and load factor. For the centreline case, daa has mixed the two. Initially, airlines increase aircraft size and load factor which reflects historic trends and known fleet orders (e.g. Ryanair replacing older B737s with B737-MAX types). In the medium-term the centreline case trends only marginally below the high case, however the high case implies a more rapid increase in aircraft size in the shorter-term.

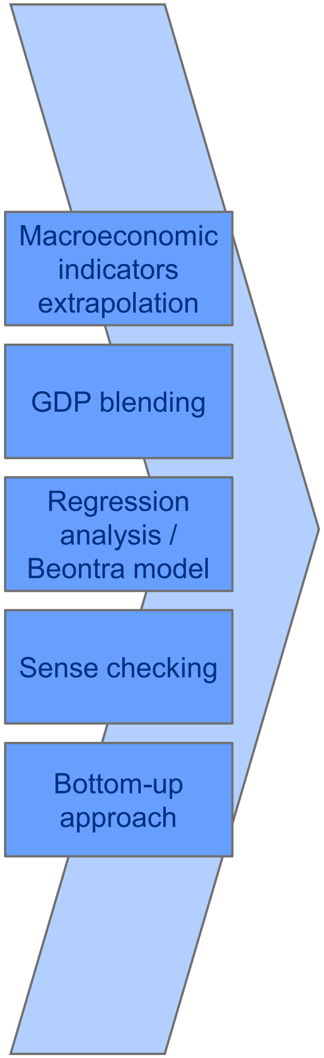
- daa has access to market intelligence that give an up to date and highly informative set of inputs to the bottom-up forecast, making the assumptions robust.
- We expect the assumptions to be within reason and acceptable and based upon a satisfactory level of analysis and detail.
- In the high case scenario, daa assumes that passengers per ATM will increase due to a trend towards larger aircraft and higher load factors and that this will ultimately happen in the low case too. The centreline is a mix of the high and low cases, with aircraft size reaching levels just below those of the high case in the medium-term, albeit at a slower rate. In the long-term, gains in both metrics slow in all three forecasts. We agree that the overall passengers per ATM is likely to grow due to the reasons outlined above.

Pax/ATM



Our review – Methodology

daa uses a sound methodology for generating long-term traffic forecast estimates and has a good sense-check process against other industry estimates. Regression coefficient checking and validation of the GDP process are two areas in which the daa methodology can improve.

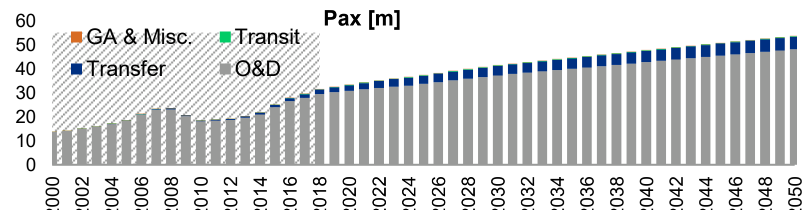


Commentary

- ► From 2023 onwards, daa has assumed a gradual tail off of GDP for the remainder of the period. This is based on historical indicators and also previous OECD forecasts which showed tail off to reflect market maturity.
- ► The macroeconomic variables used for each major market were blended between Irish GDP / country GDP to account for the different economic drivers between residents and non- residents. Other variables such as CPI and working population were considered for some markets where these improved historical regressions.
- ► A multiple regression in the Beontra tool was used for the Nordic and Benelux country cases.
- ► The model provides the regression R^2 output however it does not automatically generate the regression coefficient.
- ► The Year 1 bottom up estimate was compared against the Latest Expected Official number for Dublin Airport.
- ► For the long-term forecasts, daa compared aggregated market segment forecasts with estimates produced by Oxford Economics on behalf of the Department of Tourism, Transport and Sport (DTTaS) ('Review of Future Capacity Needs At Ireland's State Airports') as well as estimates produced by Airbus, Boeing and ACI.

- ► The extrapolation of GDP and CPI growth rates is a common procedure for long-term traffic forecasting, when published macroeconomic indicator projections by reliable sources are not available for the forecast horizon. We also agree with the built-in assumption of tailing-off of the growth rates, because markets typically show signs of maturity over time.
- ► We suggest that daa considers sources such as OECD or the USDA for GDP estimates beyond 2023 to cover the forecast period of interest.
- ► In principle, we agree with the use of a multiple regression and the blending process used are acceptable methods of prediction. Specifically for the blending, daa could validate the blending relationship using an airline by proxy country approach or with MIDT passenger shares for the countries of interest.
- ► daa refer to the regression R^2 outputs as indicating a good fit, however it is also important to consider the regression coefficient result for each regression to assess the significance of the result.
- ► daa are applying sense checks to the regression outputs which is standard practice. The Oxford Economics DUB base case forecasts reach 54m in 2050, very similar to daa's 53.6m in the centreline case. daa's North American market growth rate is similar to Boeing's (~3%) and although daa's European growth rate is lower than Airbus's (~2% v ~3%), this likely reflects the fact that DUB is a relatively mature market compared with some other European regions (for example Eastern Europe).

CAGR	2000-18	2018-22	2022-30	2030-40	2040-50	2018-50
O&D	4.4%	2.1%	1.9%	1.4%	1.2%	1.5%
Transfer	-	11.8%	3.9%	1.9%	1.1%	3.3%
Transit	-	0.0%	0.0%	0.0%	0.0%	0.0%
GA & Misc.	1.9%	(0.8%)	0.3%	(0.1%)	0.4%	0.1%



Our review – Market Segments

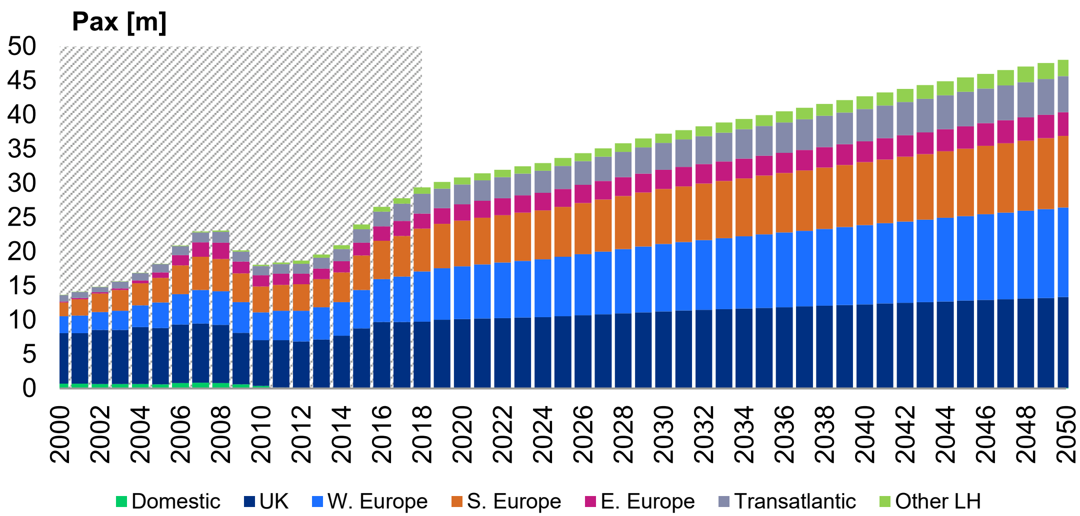
The projected growth for all the market segments analysed appears to be within reason. This analysis reflects the Pre Covid market conditions.

- International / Domestic / Individual Markets
- Full Service / Low Cost / Charter / Individual Airlines
- O&D / Transfer / Transit
- Cargo
- General Aviation

Commentary

- The daa projections for overall traffic growth at DUB show the 2018-2022 CAGR at 2.7%, not dissimilar to the projected annual GDP growth rate for Ireland, at 3.3% by the IMF (Oct 2018). Traffic grows more strongly in the early years of this period, driven by known capacity increases by DUB's airlines during 2019 as well as stronger projected economic growth in the Irish economy. The Eastern European and other long-haul markets are forecast to grow the strongest in the near term.
- In the short to medium term, the main drivers of traffic growth are likely to be Ryanair and Aer Lingus. Both carriers have new aircraft entering their fleet over the next few years and while some of these will likely replace older models, some are expected to be used to grow capacity at DUB and, in the case of Aer Lingus, to further strengthen its hub position.
- The UK market is expected to grow on average at 1.3% per annum between 2018 and 2022. This is lower than recent growth (the UK market grew by an average of 3.6% per annum between 2015 and 2018), however this reflects the IMF's October 2018 forecast GDP growth rates for the UK (~1.5% between 2018 and 2022) and uncertainty surrounding Brexit in the UK.

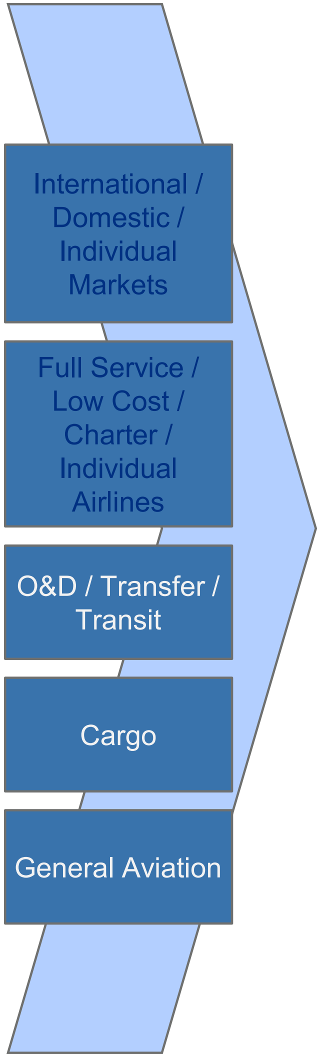
- The projected growth for the market segments appear to be reasonable.



CAGR	2000-2018	2018-2022	2022-2030	2030-2040	2040-2050	2018-2050
Domestic	(10.6%)	(0.4)	0.2%	0.0%	0.0%	0.0%
UK	1.5%	1.3%	1.2%	0.9%	0.8%	1.0%
W. Europe	6.2%	2.5%	2.4%	1.6%	1.3%	1.8%
S. Europe	6.5%	2.6%	1.9%	1.4%	1.3%	1.6%
E. Europe	18.1%	3.1%	1.5%	0.9%	1.2%	1.4%
Transatlantic	6.3%	1.5%	3.0%	1.9%	1.1%	1.9%
Other LH	-	3.3%	3.2%	3.2%	2.5%	3.0%

Our review – Market Segments

The projected growth for all the market segments analysed appears to be within reason. This analysis reflects the Pre Covid market conditions.

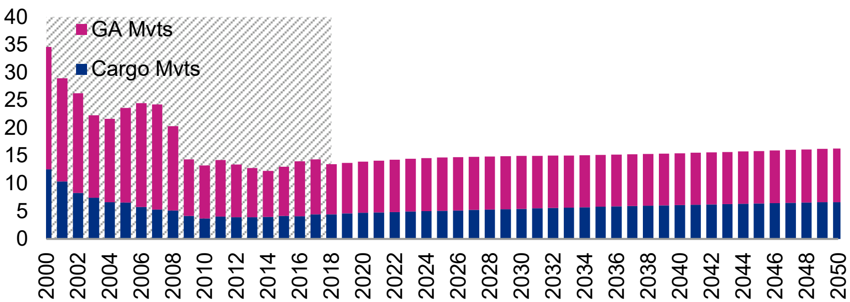


Commentary

- The transfer market is expected to grow the most rapidly in the short term, from 1.9 million in 2018 to 3.2 million by 2023. This is driven by assumptions around Aer Lingus' long-haul fleet, which is projected to grow from 17 aircraft in 2018 to 30 by 2023[1]. Beyond this, the transfer traffic is aligned to growth in the transatlantic market (which has a CAGR of 1.9% from 2018 through 2050). The volume of transfer passengers is expected to reach nearly 5.3 million by the end of the forecast period, or ~10% of the DUB's total, as the airport strengthens its hub potential with feeds between the transatlantic and short-haul markets.
- Transit passengers are expected to decline in percentage terms over the forecast period (from ~0.8% to ~0.4% of the total), but in absolute terms the number remains fairly static across the forecast period at approximately 238,000.
- Cargo volumes have been forecast using a combination of Irish Gross National Product (GNP) and the U.S. exchange rate, which led to a good fit against historic volumes. We are not aware of any changes being applied to average aircraft size.
- General Aviation (GA) represents the smallest part of DUB's traffic (approximately 0.1% in 2018) and it peaked in 2008 with approximately 48,000 passengers. daa's forecast suggests that GA passengers will remain fairly static, with ~37,000 in 2018 comparing to ~38,000 by 2050.

- The assumptions behind the growth in transfer, transit and GA passengers appear reasonable.
- Cargo ATMs increase from ~4,400 in 2018 to ~6,600 by 2050, however we are unable to comment further as we are not aware of any assumptions being made to the average aircraft size.

Non-Passenger ATMs

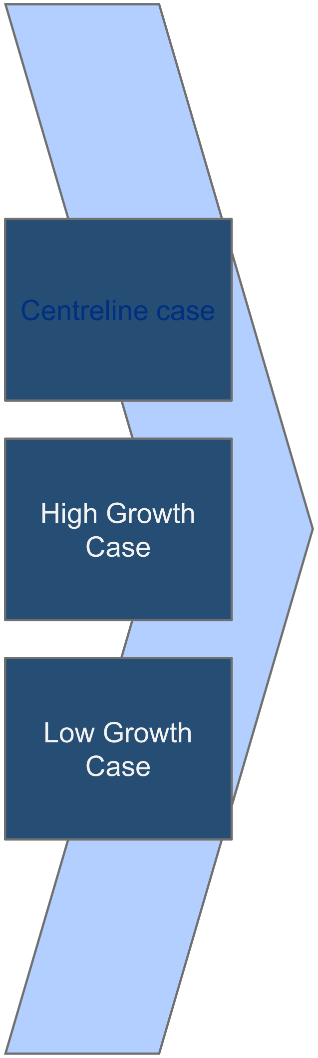


CAGR	2000-18	2018-22	2022-30	2030-40	2040-50	2018-50
Cargo ATMs	(5.7%)	2.5%	1.4%	1.2%	0.8%	1.3%
GA (non-ATMs)	(4.8%)	1.0%	0.1%	(0.2%)	0.3%	0.2%

1: Sources = daa supplied data, Irish Times November 2018

Our review – High & Low Growth Case Traffic Scenario

Overall, we consider the High and Low Growth traffic cases to be reasonable. This analysis reflects the Pre Covid market conditions.



Commentary

- ► daa developed the High Growth and Low Growth case forecasts by undertaking variations to the GDP growth rate between the years 2019 and 2029. Beyond 2029, the Centreline scenario GNP growth rates were used.
- ► Based on the Centreline scenario, the Irish GDP growth rate was increased by 1% point per year to 3.8% for the 10 year period to generate the High Growth passengers. This led to a 3.0% increase in passengers.
- ► The reverse was applied for the Low growth scenario, leading to a 1.2% increase in passengers.

- ► Overall, we consider the High and Low Growth scenario approach to be a reasonable, albeit simplified approach.
- ► daa might consider modelling a more 'informed' set of High and Low Growth scenarios, for example by looking at the upside from an expanded DUB route network and hub growth potential or the impact of a macroeconomic downturn in one of DUB's key markets (i.e. Europe or North America).
- ► We would also expect the High and Low cases to evaluate the sensitives of each market segment developed for the forecast, rather than applying the GDP growth variation in aggregate.

Our review – Design Capacity

The busy day for passengers and ATMs has been identified for the expected market categories for a design capacity assessment study and according to industry standards.

- 95% busy day to annual ratio assumptions
- Selection of busy day
- Busy day ATM development
- Busy day passengers
- Busy day fleet reflection

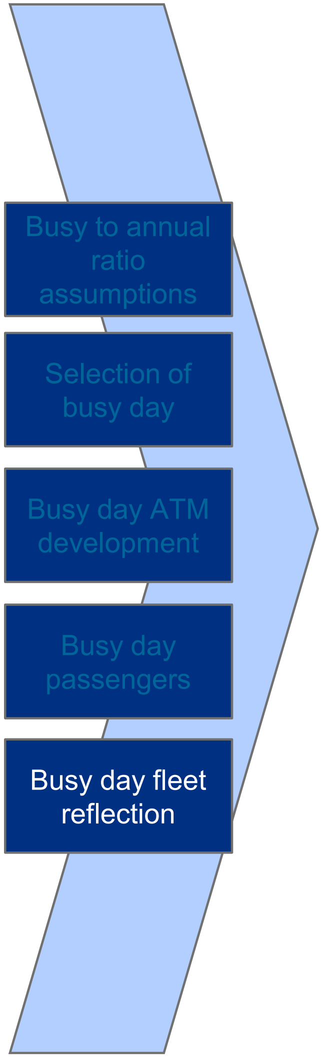
Commentary

- The base schedule is based on an approximate 95% busy day for 2019. Although a precise 95% busy day for 2019 cannot be calculated until year end, there is good visibility on the 2019 schedule enabling an approximate 95% busy day to be calculated. This day is determined to be 22 July 2019 (Monday) with 793 movements and 119,127 forecast passengers.
- The future busy day schedules for 2022, 2027 and 2040 represent hypothetical busy days applying a 95th busy hour passenger LF and peak movement activity and were calibrated based on the annual forecast figures for the main markets.
- The forecast schedules were produced based on the High Growth scenario annuals and they reflect an unconstrained scenario; slot / runway availability or any other infrastructure elements are not a constraining factor.
- The schedule for future years was adjusted through an:
  - Increase in additional flights for the future determined by the composition of annual forecast (region and airline type). The build-up of planning day flights by route type/airline type were guided by the annual trend.
  - The LF's on the forecasted busy day have been based upon the LF in a historic typical busy day (namely 2018), by airline and main market.
  - The market composition in the schedule is similar to, but not identical to, the annuals because market seasonality and market representation across the busy day have also been taken into account.
  - Flight distribution follows the existing unconstrained profile throughout the day, albeit with gradual fill of shoulder peaks for future new flights and frequencies.
  - The overall busy hour forecast produced from the planning day schedules was sense- checked using a top-down ratio analysis.

- The methodology used by daa for the development of the forecast schedules is acceptable and according to industry standards.
- We have validated the 2018 95% passenger and ATM peaks.
- A prudent approach is taken to derive busy day passenger and ATM estimates, based on BDRs at an airport total level.
- We would recommend that daa also undertakes an busy day to annual ratio approach for each of the key passenger segments.
- However, validating the markets based on current market seasonality is an acceptable sense check.
- The gradual de-peaking of the flight profile of the busy day at the airport is a reasonable assumption as the airport traffic grows in size.
- We would also recommend that daa validate the busy day to annual ratio through benchmarking busy hour projections against European comparator airports.
- We have verified that the market breakdown of the busy days mirrors the annual market breakdown – with exceptions due to seasonality on some markets. We are comfortable with this assumption being carried forward in the future busy day schedules.

Our review – Design Capacity

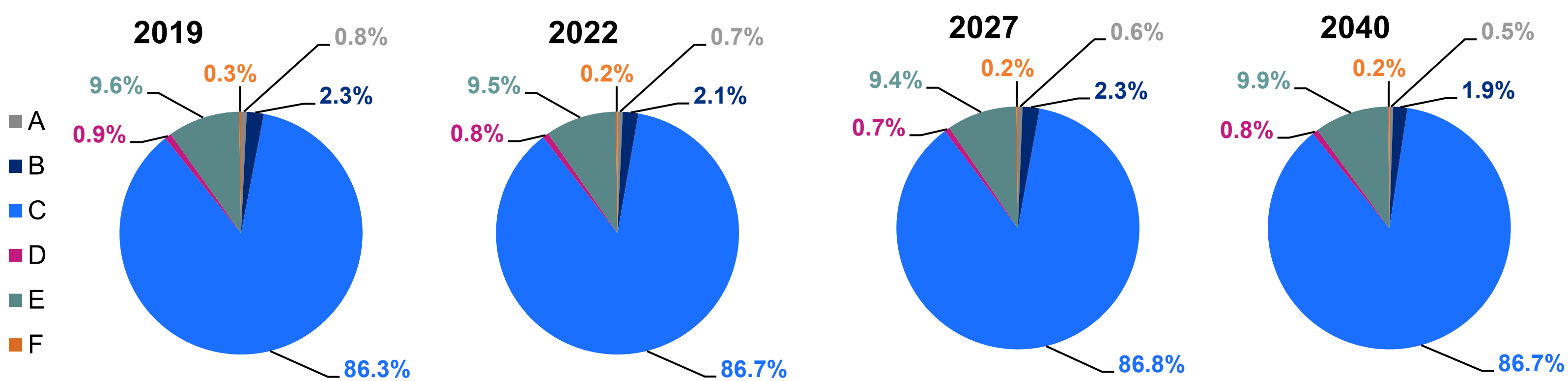
The methodology that daa has followed for the busy day schedules and all the relevant airline and market assumptions are satisfactory.



Commentary

- ► daa assumes that DUB's fleet will continue to be largely composed of ICAO Code C aircraft, although aircraft that are no longer in production (such as the RJ-85 and first generation Boeing 737 variants) are anticipated to be replaced with newer versions.
- ► Other current generation aircraft are anticipated to be replaced over the next 20 years.
- ► daa has assumed that Aer Lingus will mainly operate mainly A321NEOs, A330-200s and A330-300s on its long haul routes, while the CityJet operations flying on behalf of Aer Lingus which currently use RJ-85s will be upgraded to Embraer 190s.

- ► Fleet evolution assumptions reflected in the forecast schedules reflect a predominantly ICAO Code C operation at DUB, although we note an increase in A321LR operations which contributes to an overall rise in seats per movement from 167 in 2019 to 174 by 2040. These are largely anticipated to be operated by Aer Lingus and reflects Aer Lingus' current fleet order for eight of the type.
- ► We also checked the busy day schedules and their composition in terms of airline mix, passenger load factors and destinations. The airline mix is forecast to remain relatively constant, with Ryanair and Aer Lingus continuing to account for ~60% of the operations and the destination market mix is similar to the annual market mixes, with the UK and Europe forecast to remain the largest markets. We note the passenger load factors for certain airlines are close to the maximum, an assumption that can be justified considering the schedules represent a busy days.
- ► The methodology that daa has followed for the busy day schedules and all the relevant airline and market assumptions are satisfactory.



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Appendix 2A. Dublin Airport Proposed Night Quota System

Document Classification: Class 1 - General

Dublin Airport
Night Quota System Proposal – Response to RFI.

Document: 3870-AnnualNightQuota – RFI Final
Date: 30th July 2021
Version: Issued

Author: Andy Knowles

Anderson Acoustics

Introduction (1)

- In December 2020 daa submitted a planning application to Fingal County Council (FCC) to modify planning conditions contained in the North Parallel Runway Planning Permission (FCC Reg. Ref:. F04A/1755; ABP Ref: PL06.217429) that restrict the use of the airport at night once North Runway becomes operational.
- The Application seeks to amend and replace Condition 3(d) that restricts the use of the North Runway between 23:00 and 07:00; and Condition 5 that restricts the average number of night-time aircraft movements at the airport overall to 65 movement/night once the North Runway becomes operational.
- In addition to already planned measures (outlined in the Dublin Airport Noise Plan 2018-23) and noise measures already required under the parent planning permission daa proposed a package of mitigation measures consistent with the ICAO Balanced Approach including:
  - a preferential runway use scheme during the night;
  - a Residential Sound Insulation Grant Scheme;
  - a Night Quota System (NQS); and
  - a comprehensive noise performance monitoring framework (consistent with the Aircraft Noise Regulations 2019).
- These measures were assessed in accordance with EU598 and enabled cost-effective compliance with a candidate Noise Abatement Objective (cNAO) proposed by daa, and daa's key noise goals (see Section 3 for overall framework).
- It is recognised that it is not daa's responsibility to define the NAO. However, it was considered necessary to develop a cNAO in order to undertake an EU598 assessment and associated cost-effectiveness analysis in line with the ICAO Balanced Approach.
- Following grant of North Runway Planning Permission in 2007 Dublin Airport experienced a strong sustained growth trajectory, with the current runway system at capacity during peak times in 2018 and 2019. The geographical location of Dublin Airport and the 1hr time difference between it and mainland Europe, means that flights need to leave Dublin before 7am to arrive at their destination for the start of the working day.
- In 2019, driven by short haul services operated by aircraft based at Dublin Airport, demand for night flights (23:00-07:00) was over 100/night, with 113/night associated with regularly scheduled services on a typical busy Summer day (aligns with the 92-day summer referenced in North Runway Condition 5).
- In 2020 and into 2021, with the Covid-19 Pandemic and as per all other international airports, Dublin Airport saw a significant drop in air traffic movements and passenger numbers. Strong sustained growth is expected to return post pandemic.
- Since the December 2020 application, forecasts for post-pandemic recovery have been revised. Mott McDonald, on behalf of daa, have forecast that to sustain the airport's recovery traffic will rise to 116/night when the airport returns to 32m annual passenger traffic levels around 2025.
- The operating restrictions introduced by Conditions 3(d) and 5 will have a significant impact on short haul services operated by aircraft based at Dublin airport. The assessed impact of these restrictions is a loss of around 1.6m passengers per year and a cumulative loss of 6.3 million passengers over the 4-year period 2022-2025.
- daa's proposed Night Quota System is part of a package of measures that will facilitate recovery whilst managing the impacts of the associated growth, such that the overall effects of noise will remain better than 2018 into the future.

Introduction (2)

- Cost effectiveness analysis (CEA) concluded that a night-time operating restriction was not needed to meet the cNAO – the already proposed runway operating procedure and advancements in aircraft noise were sufficient. However, it was felt reasonable to offer an alternative to the 65ATM/night cap as part of an overall noise management framework.
- A Night Quota System (NQS) with an Annual Night Quota (ANQ) of 7,990 applied to runway operations between 23:30-05:59 was proposed as a cost-effective replacement for Condition 5.
- Following review of the Application, FCC and the Airport Noise Competent Authority (ANCA) issued a Request for Information (RFI) which, amongst other things, sought clarification and further explanation of some of the aspects of the NQS.
- This document presents on update to the previously issued report outlining the NQS and provides a response specifically to related RFI clarifications. Responses are provided in the context of the noise goals and cNAO proposed by daa as no formal NAO is in place, nor have alternatives to the cNAO been proposed.
- daa's proposal for a NQS based based on an ANQ applied to the 23:30 to 05:59 period of 7,990 are unchanged.
- Since the December 2020 application, post-pandemic recovery forecasts have been revised. Analysis of future Quota Count (QC) have been based on these revised forecasts from 2022 to 2040.
- Whilst a number of scenarios are considered in the overall RFI responses, two have been analysed with respect to the daa NQS proposals and are considered in this document:
  - Scenario D – A revised forecast for the Relevant Action Application, consistent with the revised EIAR, where a passenger limit of 32 million passengers per year exists beyond 2025; and
  - Scenario A – a growth forecast where the 32 million passengers per year limitation is removed beyond 2025.
- The document takes the following structure:
  - Section 1: A summary of the proposed NQS related RFI points;
  - Section 2: Considers the NQS in the context of an overall framework for managing noise.
  - Section 3: Noise Performance Reporting
  - Section 4: Summarises key considerations for the NQS
  - Section 5: Presents draft implementation and management proposals for the NQS
  - Section 6: Outlines the approach to calculating the 6.5h ANQ based on the original application forecasts.
  - Section 7: Presents performance of the revised Application forecasts with respect to the proposed 6.5h ANQ
  - Section 8: Presents calculations for an alternative 8h ANQ
  - Section 9: Presents Performance of the revised application forecasts with respect to the alternative 8h ANQ.
  - Annexes

Section 1:
RFI

The RFI relating specifically to the proposed Night Quota System are summarised and presented in the following slides.

RFI (1)

RFI	Noise/ Doc Ref	Request	Comments
1	EIAR Chapter 1 - It appears that the noise quota count does not apply for the 1.5 hours of shoulder period.	The Applicant is requested to clarify why the noise quota count does not apply for the periods 23:00-23:30 and 06:00-07:00.	See Section 4 for discussion.
40	Dublin Airport Proposed Night Quota System Page: 15 "The proposed NQS will serve to balance the effects of night noise from the forecast night-time growth, encourage the use of quieter aircraft; and will provide a layer of assurance that the overall effects of noise at night arising from the proposed changes are managed and controlled such that they will be no worse than in 2018, and less than envisaged at the time of the North Runway Planning Permission."	The Applicant is requested to provide any analysis of the impacts of its proposed shortening of the Night Period – in particular, implications for local residents in the period that it is proposing to remove from the Night Period definition.	The overall impact across the full 8h night period are considered in the revised EIAR.
47	Dublin Airport Proposed Night Quota System. Page: 2 "The NQS proposal includes an Annual Night Quota (ANQ) allowance applied to scheduled operations across the Night Quota Period (23:30 to 06:00)"	The Applicant is requested to provide any analysis it has undertaken (included safeguarding considered) in relation to noise impacts in the period 2300-2330 or 0600-0700?	The impacts across the full night period are considered in the EIAR. Sub-sections of that period have not been analysed.
74	EIAR Main Report 2.1.2.2. Condition 5 of the North Runway Permission "A detailed Noise Monitoring Framework to monitor the noise performance with results to be reported annually to the Aircraft Noise Competent Authority (ANCA), in compliance with the Aircraft Noise (Dublin Airport) Regulation Act 2019."	The Applicant is requested to provide details of how it envisages its Noise Monitoring Framework to operate and whether this will include the monitoring of noise mitigation measures, noise insulation and operating restrictions. The Applicant should describe how it foresees this functioning under Part 4 of the 2019 Act.	See Section 2 for the overall framework and Section 3 for reporting.

RFI (2)

RFI	Noise/ Doc Ref	Request	Comments
75	EIAR Main Report 2.1.2.3. The Proposed Quota Count System "ATM from 2018 which was 0.52 per ATM"	The Applicant is requested to provide the total annual noise quota for 2006, 2011, 2016, 2018 and 2019 for the 6.5 hour noise period as proposed by the Applicant along with equivalent QC per ATM.	See ANCA template report and Section 7 herein.
76	EIAR Main Report 2.1.2.3. The Proposed Quota Count System "The proposed change from the night-time aircraft movement cap of 65 movements per night to the ANQ, will allow growth in overall air traffic movements at night whilst ensuring that the overall effects of aircraft noise do not exceed those in 2018 in accordance with the cNAO."	It is noted that the description of the proposed ANQ throughout the Application is of a control which seeks to limit aircraft noise rather than reduce it. Reduction is a key aspect of aircraft noise management and some consideration of this should be given. The Applicant is requested to propose review periods for the ANQ and how the ANQ could be progressively reduced.	See Section 4 for discussion on review periods and reduction.
82	EIAR Main Report Table 4-1 Feasible preferential runway use measures	The Applicant is requested to describe why the proposed quota system is based on a time period of 23:30 to 05:59 whilst the runway preferential use scenarios relate to the period 23:00 to 06:59 or 00:00 to 05:59. The Applicant is requested to consider the feasibility of a quota system which operates over the whole 8-hour night period i.e. 23:00 to 06:59? Section 2.1 of the EIAR states that during 2018/19 the South runway was over capacity from 06:30 to 08:00. The Applicant is requested to advise on whether a runway preferential use scenario where the North Runway is available from 06:00 and 07:00 is a feasible option. The Applicant is requested to demonstrate the need to allow North Runway operations at night from the North Runway during the period 2300-0000 in the context of its 32 mppa restriction?	See Section 4 for discussion on time period for NQP and consideration of other options. Section 8 and 9 provides information relating to an equivalent 8h Night Quota Period.

RFI (3)

RFI	Noise/ Doc Ref	Request	Comments
132	Dublin Airport North Runway, Regulation 598/2014 (Aircraft Noise Regulation) Forecast Without New Measures and Additional Measures Assessment Report 3.1 .4 STEP 3 – NEED FOR OPERATING RESTRICTION MEASURE(S) (The proposed QC measure would assign a QC value to each individual aircraft movement based on the certified noise level of that aircraft. Lower QC values are applied for aircraft with lower noise levels, higher values for noisier aircraft. The QC accumulates for each air traffic movement (ATM) against the Noise Quota (NQ) across the applicable period. As such, the system allows a greater number of quieter aircraft movements within a given quota, encouraging the use of quieter aircraft. An ANQ has been developed for the period 2330 to 0600 (known as the NQP) consistent with airports operating similar QC based systems. daa proposes to apply an ANQ of 7,990 for each year from the opening of the North Runway to 2025. The ANQ is based on the 2025 forecast fleet mix and ATMs, and is not expected to involve a substantial cost to implement. Refer to the Noise Quota Report by Anderson Acoustics for more information on the proposed ANQ.)	The Applicant is requested to provide further information regarding the proposed Noise Quota System and confirm whether:- a. a noise quota system aligning to an 8-hour night-time period 2300-0700 been considered. b. the quota system is based on the current UK Department for Transport system. Has a movement limit or other control been considered as part of the noise quota period? c. Has the quota system has been considered for forecasts extending beyond 2025? d. a review period for the quota system been considered? e. an incremental reduction in quota over time has been considered?	See Section 4 for discussion of considerations. See Section 6 and 7 for future years See Section 8 and 9 for consideration of equivalent 8h NQP.
138	Dublin Airport Proposed Night Quota System - Introduction (The NQS proposal includes an Annual Night Quota (ANQ) allowance applied to scheduled operations across the Night Quota Period (23:30 to 06:00).)	The Applicant is requested to provide analysis of what safeguards are proposed in relation to noise impacts in period 2300-2330 or 0600-0700 and to provide details of other quota periods which could be used instead, such as an 8-hour night period or a period to operate alongside voluntary restrictions on the use of the runways.	See Section 4 for discussion and Section 8 for consideration of 8h NQP.

RFI (4)

RFI	Noise/ Doc Ref	Request	Comments
139	Dublin Airport Proposed Night Quota System Considerations for a Night Quota System (Whilst analysis indicates that source, operating procedure and land use measures meet the cNAO, daa is proposing an NQS to provide assurances that forecast noise conditions in 2025 will meet the cNAO since part of that compliance will be as a result of airlines updating the fleet operating at Dublin Airport to comprise more, quieter aircraft as indicated in the forecast.)	The Applicant is requested to demonstrate that the proposed 6.5 hour NQS will ensure the meeting of an 8-hour night-time objective.	See Section 2 for consideration of NQS as part of an overall framework.
140	Dublin Airport Proposed Night Quota System Considerations for a Night Quota System A Night Quota System (NQS) and EU598 (As per QC type systems in other jurisdictions, a detailed methodology and procedures would need to be developed and implemented which would need to include provision for late operations and other non-scheduled flights to balance their effects on the local community with the impacts that would arise on the network impact should they be prevented.)	This statement is noted and demonstrates that further development of the NQS is necessary. The Applicant is requested to provide further information regarding the mechanics of the proposed NQS in whatever form it is to take. For example, are any exemptions proposed from the scheme, what will form the basis of the QC points assigned to aircraft. This request should be read alongside other comments made by ANCA in relation to the proposed NQS.	See Section 4 for discussion and Section 5 for a draft implementation proposals.
141	Dublin Airport Proposed Night Quota System Developing a proposed Annual Night Quota All scheduled and non-scheduled ATMs during the NQP (forecast in 2025 to determine an Annual Night Quota to be used for the period 2022-2025 for scheduled ATMs.)	The Applicant is requested to demonstrate that all available control mechanisms, in addition to QC, has been considered. For example, determining the health impact which may be acceptable in line with any NAO brought forward by ANCA and then calculating the ANQ by working backwards from there to determine the fleet mix changes required and the number of ATMs that could then be allowed etc. Given the time horizon for the assessment presented within the Application, the Applicant is requested to provide additional data to demonstrate whether the consequences of moving to such a QC control over the long term will remain appropriate.	In the absence of an NAO it is not possible to consider all available control mechanisms. daa has considered a range of mechanisms consistent with the ICAO Balanced Approach and the application of EU598 with reference to a cNAO. The approach proposed has included a package of measures that have been assessed as cost effective. Sections 2 and 3 consider the NQS proposals in the context of an overall package of measures. Section 4 and beyond considers the details of the proposals and the longer term evolution of QC performance.

RFI (5)

RFI	Noise/ Doc Ref	Request	Comments
142	Dublin Airport Proposed Night Quota System Total Annual ATM and QC. Arrivals and departures. ATM	The Applicant is requested to further explain the ATM increase in night period while total ATMs are assumed flat. Additionally, the Applicant is requested to demonstrate that there will not be a consequence of inflating the QC allowance calculated as part of the scheme. The Applicant should note comments made by ANCA in relation to the forecasts and fleet mix assumptions.	See Section 4 for discussion with reference to inflation. The QC/ATM is lowest in 2018, it is higher in 2016, 2017 and 2019. By using the lower value for 2018 means that the calculated ANQ is reduced compared with if the equivalent value for 2016, 2017 or 2019 had been used.
143	Dublin Airport Proposed Night Quota System Calculate NQP Annual Night Quota = 7,990	The NQP will be influenced by aircraft mix assumptions, making these assumptions extremely important. The is no explicit visibility of these assumptions and it is difficult for ANCA to identify how this annual quota has been calculated and the requirement for the proposed headroom. The Applicant is requested to provide further information to demonstrate how the annual quota has been calculated is requested.	Assumptions around QC for each aircraft type in the historic movements and forecast analysis are presented in Annex B. A simplified forecast with QC allocated to each aircraft movement has been provided as part of the ANCA reporting template.
144	Dublin Airport Proposed Night Quota System Calculate NQP Annual Night Quota = 7,990 (The ANQ tolerance provides an allowance of ~5% for inherent variability associated with forecasts. The analysis has assumed a single, typical QC value for each aircraft type. There are a range of QC values that could apply to any one type based on engines and aircraft weight. The ANQ tolerance therefore provides an allowance for some variation between the assumed QC for a flight and the QC for the aircraft that may actually operate. The next slide provides additional)	The Applicant is requested to provide further information on how the QC value for each aircraft type has been selected and which parameters have been used as part of the selection (i.e., take-off weights and consideration of destinations served?). The Applicant is requested to identify any requirement for marginally compliant aircraft operations during the night period. This is an important consideration as the allowance may increase the ANQ, and hence the allowable number of night ATMs over and above the actual need i.e., the unconstrained position.	Assumptions around QC for each aircraft type in the historic movements and forecast analysis are presented in Appendix B. A simplified forecast with QC related to each movement has been provided as part of the ANCA reporting template. Implementation is considered further in Section 5.

RFI (6)

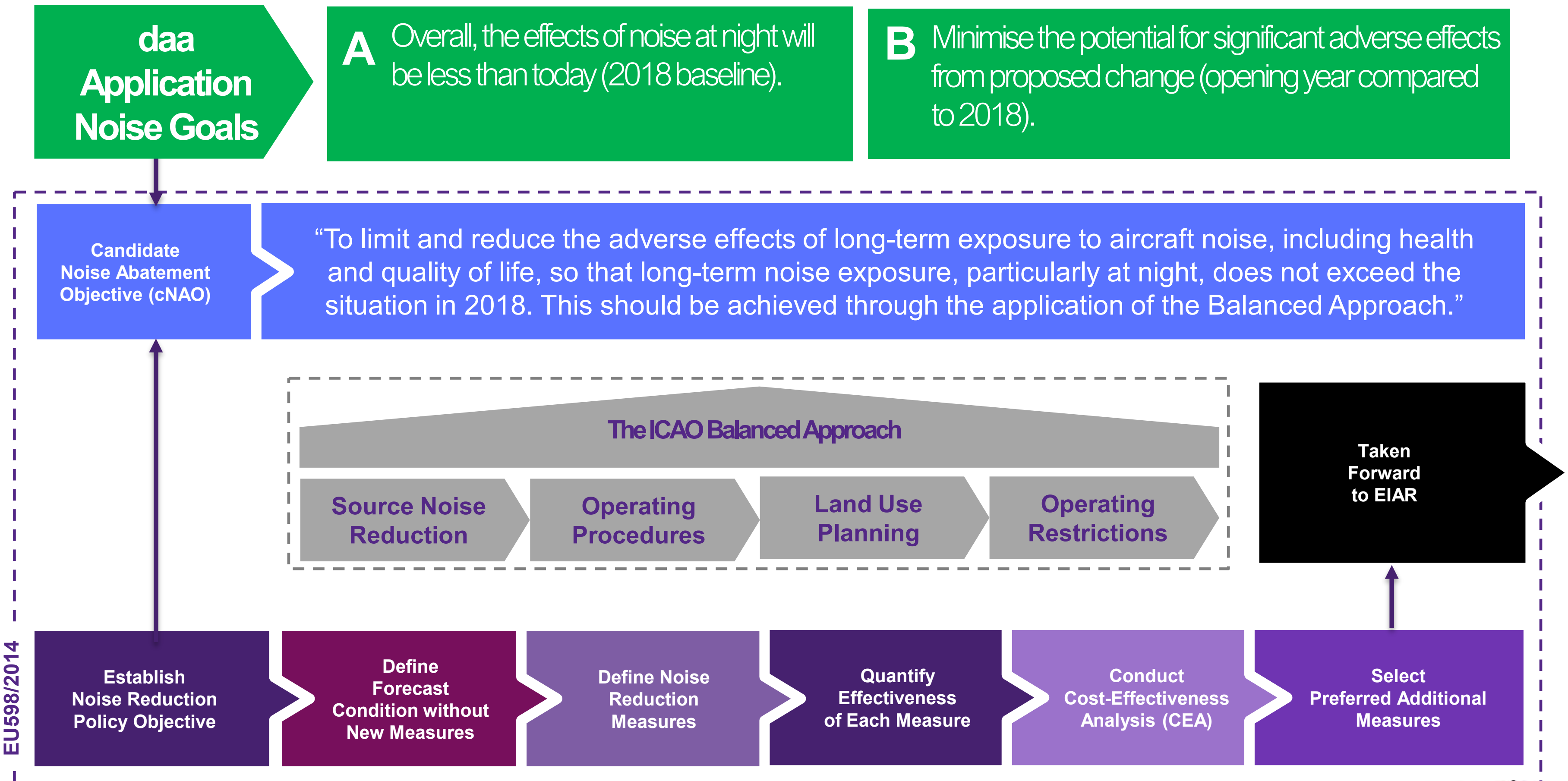
RFI	Noise/ Doc Ref	Request	Comments
145	Dublin Airport Proposed Night Quota System Proposed Night Quota System. Summary.	The Applicant is requested to provide the methodology used to formulate the proposed noise quota be provided. As presented, it appears to assume that residents are indifferent between fewer, nosier flights and more frequent, quieter flights (as long as QC count is the same). The Applicant is requested to provide detail for this implicit assumption and to confirm whether consideration been given to incrementally lowering the quota over time. The current approach adopted by the proposal is that the airport may continue to increase night-flying up to a limit without necessarily reducing noise over the longer term. Given the forecasts provided extend only to 2025 there is no evidence to demonstrate that objectives to reduce aircraft noise can be influenced by the proposed controls.	See Section 4 for discussion on considerations with respect to the NQS including review period and reduction. Section 6 summarises the methodology for developing the ANQ.

Section 2: Overall framework

The Night Quota System proposal is one element of a cost-effective package of measures to manage the effects of aircraft noise at night.

daa overall approach to managing noise and growth.
Night-Noise Goals: Candidate Noise Abatement Objective

ICAO Balanced Approach. EU Regulation 598/2014 inc. Cost Effectiveness Analysis (CEA)



Regulation 598 Process and Initial Findings

Establish Noise Reduction Policy Objective

- Candidate NAO established, which limits effects of aircraft noise to no worse than granted in original North Runway permission and no worse than recent activity in 2018/19.
- Primary metrics are Highly-Annoyed and Highly Sleep Disturbed populations.

Define Forecast Condition without New Measures

- 32 MPPA forecast year (2025).
- North Runway with no restrictions and fully mixed-mode runway use.
- Includes19 existing and previously planned noise reduction measures.

Define Noise Reduction Measures

- 14 potential additional noise reduction measure categories were considered.
- 8 preferential runway use measures proceeded forward for further analysis.
- Additional sound insulation measure proceeded forward for further analysis.

Quantify Effectiveness of Each Measure

- Noise impacts modelled for the Forecast Conditions without New Measures scenario.
- Noise impacts modelled for 8 preferential runway use scenarios.
- Noise impact reduction evaluated for 55 L_{night} sound insulation scheme.
- Quantify costs of effective measures

Conduct Cost-Effectiveness Analysis

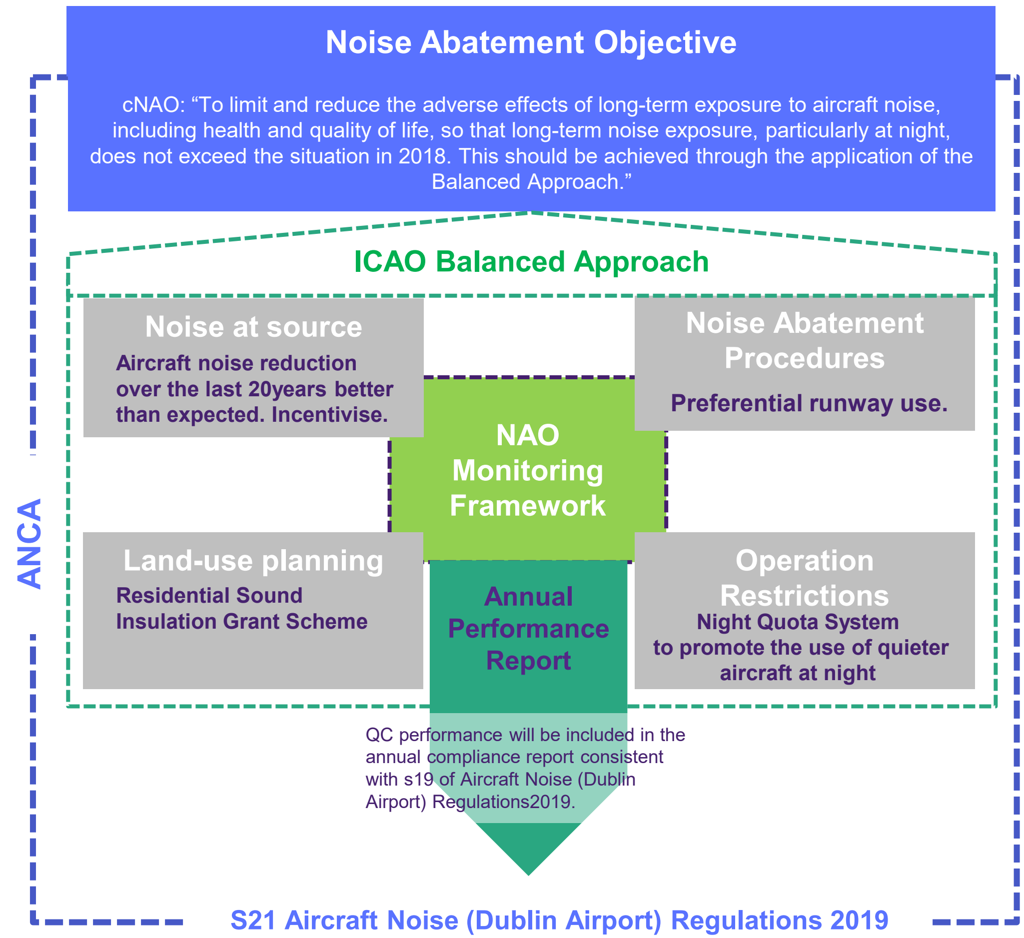
- 3-step evaluation process.
- Scenario 2 (extension of Option 7B into night shoulder hours, preferential runway use; 55dB L_{night} Noise Insulation Scheme (NIS) identified as the most effective set of measures.
- **Annual Night Quota (ANQ)** measure proposed to ensure conditions to 2025 not worse than 2018.
- Cost–effectiveness of Scenario 2 preferential runway use and 55dB L_{night} SIS were evaluated relative to Permitted Conditions 3(d) and 5.

Select Preferred Additional Measures

- Preferred additional measures:
  - Scenario 2 preferential runway use;
  - 55dB L_{night} NIS;
  - **ANQ 23:30 to 06:00**.

Night Quota System (NQS) is just one part of a package of cost-effective measures aimed at ongoing compliance with NAO.

- The proposed measures, which have undergone cost-effectiveness analysis consistent with the requirements of EU598, are held together by the proposed NAO Monitoring Framework (NMF).
- The NQS is not proposed as the single measure to deliver compliance with the cNAO or to manage noise, but as one element of a cost-effective package of measures based on the ICAO Balanced Approach that work together.
- The NQS was developed as a practical means to aid control of noise output from aircraft operations and incentivise the use of quieter aircraft at night during the most sensitive periods.
- The proposals for a NMF include the production and submission to ANCA of an Annual Performance Report consistent with s19 of the Aircraft Noise (Dublin Airport) Regulations 2019 (further details of reporting proposals are presented in Section 3) and community noise monitoring and reporting. Compliance metrics are proposed.
- Where reported performance indicates concerns with respect to the NAO, appropriate modifications and actions would be considered through consultation between ANCA and daa consistent with the Aircraft Noise (Dublin Airport) Regulations 2019.
- It is noted that the cNAO upon which the analysis was based may not be the final NAO. Changes to the NAO from the cNAO proposed by daa could require a different set of measures and subsequent re-evaluation of those measures consistent with EU598.



Section 3:
Noise Performance Reporting

Night Quota System performance will be reported annually alongside other areas of NAO reporting consistent with the requirements of s19 Aircraft Noise (Dublin Airport) Regulations 2019.

Noise Reporting Framework

Noise output from aircraft at night will be reported as part of the Aircraft Source Noise and Operational measures in terms of QC derived metrics alongside specific NQS reporting.

- **Monitoring and Reporting**

  The following will be reported:

  - Effects of aircraft noise:
    - The number of people highly annoyed and highly sleep disturbed. Consistent with EU Directive 2020/367 and reported for the previous calendar year and forecast 2025.
  - Aircraft noise exposure:
    - Aircraft noise contours and associated area, population and dwellings (and other noise sensitive properties). In 5 dB bands, from 45 dB to 75 dB L_{den} and 40dB to 70 dB L_{night}. For the previous calendar year and forecast 2025.
  - **Aircraft Source Noise Measures:**
    - **Night Quota System - the number of ATMs and QC will be reported for the previous year, the next year NQP and out to an agreed forecast year, with a break down for each of the QC bands and the QC/ATM.**
    - **The same information will be reported for the full Night Period.**
  - **Operational Measures**
    - **For the previous year calendar year, the number of arriving and departing aircraft and their associated QC totals using each runway during the periods 23:00-00:00, 00:00-06:00 and 06:00-06:59.**
    - **This will be averaged to indicate "per night" equivalent values. This will also be provided for a monthly breakdown.**
  - Noise Insulation Scheme Reporting.
    - The number of dwellings eligible and total grants administered under night noise insulation scheme to be reported each year.
  - Community Noise Reporting (in addition to Condition10)
    - Noise reports will be developed working with ANCA and the local communities to present an overall picture of the airport's operation and effects which could include the information above.
    - In consultation with ANCA and local communities daa will develop a community noise monitoring programme to report specific noise related outcomes from the airport operation.
    - daa in collaboration from IAA will make available noise and flight track information to the local community.
    - The number and nature of noise complainants will be reported monthly and annually.

- **Night Quota System Performance Reporting**
  - Specific **ANQ performance be monitored and reported annually**.
  - This would include reporting the actual use of the ANQ for the previous year and forecasts for future years to 2025 (or other forecast year to be agreed) and would be split by seasons (summer and winter).

- **NAO Performance Reporting**

  The following metrics are proposed for consideration of performance with respect to the NAO for the previous year and 2025 with respect to effects and exposure:

  - The overall number of people exposed to noise >= 55dB L_{den} compared with the equivalent value for 2018
  - The overall number of people considered highly annoyed compared with the equivalent value for 2018
  - The overall number of people exposed to noise >=40dB L_{night} compared with the equivalent value for 2018.
  - The overall number of people considered highly sleep disturbed compared with the equivalent value for 2018.
  - The Area of the contour outlining those exposed to significant levels of noise at night (>55dB L_{night}).

  Where NAO performance reporting raises concerns about compliance with the NAO these would be discussed and considered in consultation between ANCA and daa consistent with the ICAO Balanced Approach, EU 598 and the Aircraft Noise (Dublin Airport) Regulations 2019.

Notes:
NQP – the proposed Night Quota Period - 6.5h, 23:30-05:59
Population analysis: Where there is a comparison of population or effects with the equivalent for 2018, the population dataset used for deriving 2018 figures will be used consistently for all calculation years.

Section 4:
Key Considerations for the Night Quota System (NQS)

This section provides provides further explanation of the factors considered during the development of the Night Quota System (NQS) and provides response to related RFI and specifically:

- The basis of the Night Quota System (NQS).
- EU598 and Operating Restrictions
- The Annual Noise Quota (ANQ)
- Review periods and reduction

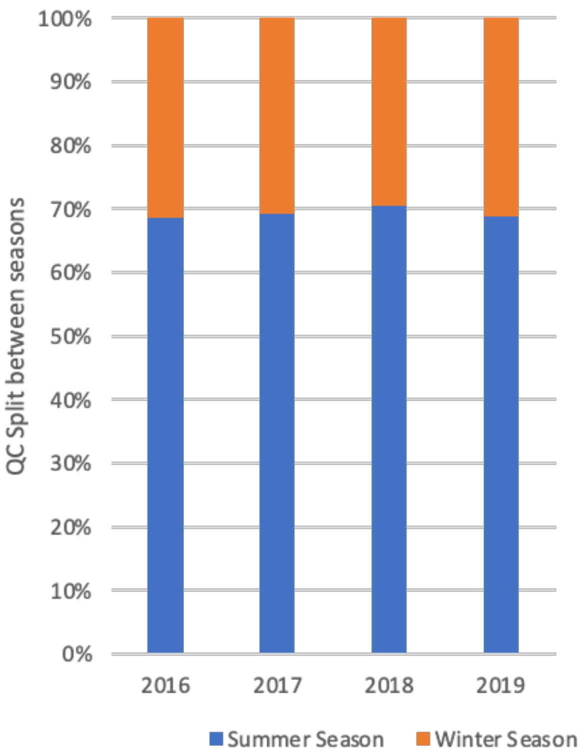
Considerations for the Night Quota System (1)

- The **Night Quota System** is designed to limit the overall amount of noise produced by aircraft using an airport based on a Night Quota allowance for a given time period. daa proposals are based on the system currently in operation at the UK London Airports.
- A **QC** (Quota Count) value is assigned to each individual aircraft movement based on noise levels provided on the aircraft's Noise Certificate. Current QC bands are 0.125, 0.25, 0.5, 1, 2, 4, 8 and 16 – a lower QC for aircraft with lower noise levels, higher QC for noisier aircraft. Aircraft have separate QC values for arrival and departure.
- The QC for each aircraft movement accumulates against an **Annual Noise Quota** across a chosen time period across the night (the **Night Quota Period**, NQP). The NQP in this proposal is defined as **23:30-06:00** which is consistent with the UK London Airports. As such, a greater number of quieter aircraft movements could operate within a given quota, thereby encouraging the use of quieter aircraft at the airport, whilst keeping overall noise levels consistent.
- **The proposals for a Night Quota System are for an Annual Night Quota (ANQ) of 7,990 applied to a 6.5h Night Quota Period (23:30 to 05:59)**. Draft implementation proposals are provided in Section 5 and are based on those in place currently at Stansted Airport. These will be finalised in advance of the ANQ coming into place should the Relevant Action application be granted permission.
- daa consider that a movements-based constraint would not promote the use of quieter aircraft during the night consistent with achieving the effects-based outcomes of the cNAO. The use of Quota based approach incentivises airlines to continue to modernise. The overall 8h effects-based outcomes of the cNAO provide an inherent constraint on movements.
- Considerations for the development of the Night Quota System include:
  - The implications of EU598
  - Development of an Annual Noise Quota allowance
  - The duration of the Night Quota Period and "shoulder hours"
  - Implementation and management processes
  - Other special cases such as allowances by runway, or by night
- **EU598**
  - EU598 considers an NQS measure to be an operating restriction. Analysis indicates that proposals for replacement of Condition 3d and 5 with Scenario 2 (and other measures) are sufficient for cNAO compliance and therefore, consistent with the application of EU598, operating restriction measures are not necessary.
  - Whilst analysis indicates that source, operating procedure and land use measures meet the cNAO, daa is proposing an NQS to provide further assurances around the control of noise at night and to encourage the continued update of the fleet operating at Dublin Airport to comprise more, quieter aircraft (consistent with noise at source considerations as per the ICAO Balanced Approach).
  - The overall effects of use of quieter aircraft are already included in the forecast operations for 2025; there is no modelled reduction in noise levels if the ANQ is included - the ANQ provides assurances of improving future fleet noise output.

Considerations for the Night Quota System (2)

- **The proposed Annual Night Quota (ANQ)**
  - daa has proposed an ANQ of 7,990 for the NQP of 23:30 to 06:00 according to the process presented in Section 6. This proposal is unchanged from the December 2020 Application.
  - The ANQ would apply to forecast scheduled and non-scheduled ATMs. Additional consideration will be required for late operations in the NQP (flights scheduled before 23:30 but have been found on-occasion to operate after 23:30. A tolerance is needed to allow for variability inherent in forecasts.
  - Daa's proposal for a NQS based based on an ANQ applied to the 23:30 to 05:59 period of 7,990 are unchanged.
- **ANQ – summer and winter seasons**
  - Draft implementation proposals have been developed (included in Section 5) that propose the ANQ be split across winter and summer seasons for effective management and seasonal scheduling requirements.
  - Analysis of historic QC use (with QC applied retrospectively as no similar system is currently in place) indicates that the annual quota would be split approximately 70%/30% between summer and winter seasons respectively as shown in the figure. See also Annex C.
  - These implementation proposals will be finalised in advance of the ANQ coming into place should the Relevant Action application be granted permission.

Historic ANQ split across summer and winter seasons 2016-2019



Considerations for the Night Quota System (3)

- **Proposed 6.5h Night Quota Period.**
  - An Annual Night Quota (ANQ) is proposed for a Night Quota Period (NQP) of 23:30 to 06:00. This period has been selected to be consistent with airports operating similar QC based systems.
  - The NQP protects the periods of the night-time considered to be most sensitive to local communities, whilst balancing growth in the 06:00 to 07:00 period that is essential for the development of European short-haul connectivity (time difference constraints) and will accommodate the forecasted growth in the night period. The proposed NQP and ANQ are not expected to cause operational constraints up to 2025.
  - Since the original application was submitted in December 2020, the forecasts have been revised. Performance with respect to the proposed ANQ has been analysed and is summarised Section 7 for the 32mppa and Growth scenarios.
- **Special cases**
  - A number of special case examples have been referenced in the RFI such as Night Quota allocated for specific runways; sub-time periods of the NQP; or by night. Detailed implications of these options have not been analysed as they are considered impractical to implement. No other options have been considered.
- **Consideration of an 8h Night Quota Period**
  - A NQP covering the full night period (23:00 to 07:00) was rejected in the initial analysis due primarily to the implications for growth in 06:00 to 07:00 hour and the consequential likely impact on cost-effectiveness. Especially considering the need for post-pandemic recovery.
  - With consequential potential effects on the airport's competitiveness with Europe and UK Airports it was considered unnecessary to take the full night period option forward.
  - Further, the primary outcomes for the NAO reflect the effects of noise across the whole 8h night period (based on reducing metrics associated with population exposure and sleep disturbance). The measures proposed without the NQS have been found to be sufficient to meet the proposed cNAO and therefore an 8h NQP was felt unnecessary.
  - Whilst an 8h NQP is not proposed by daa, analysis has been undertaken and presented herein (based on revised forecasts) to indicate calculation of equivalent ANQ and subsequent performance over forecast future years with respect to this. The summary outcomes are presented in Section 8 and Section 9 for the 32mppa and Growth scenarios.
  - It is considered that the requirement to meet the NAO places an effects based constraint around the full 8h night period without the need for a specific aircraft quota (or movement) constraint in that period.
  - No other NQP options have been considered.

Considerations for the Night Quota System (4)

- **Review Period for the Night Quota System**
  - daa proposes a review of the ANQ at appropriate interval after a decision has been made on the Relevant Action - should the Relevant Action application and ANQ be consented it is considered reasonable that a review be undertaken 5 years after the ANQ becomes operational.
  - Further reviews and associated consultations could then be undertaken every 5 years. Review periods of less than 5 years are considered impractical.
  - ANQ Review will need to consider lead times for scheduling and allow sufficient time for corrective action to be taken.
- **Annual Night Quota Reduction**
  - At this time, given the need to enable recovery post-pandemic and the uncertainties inherent in forecasting, reductions in ANQ are not proposed and have not been considered. Future ANQ reductions could be considered in line with reviews above.
- **Reference year for QC/ATM target**
  - The process for developing the ANQ used the mid-point of the difference in QC/ATM between 2018 and 2025 A reference year of 2018 was selected to align with the cNAO.
  - Analysis of historic movement data over the period 2016-2019 indicates that the QC/ATM was lowest in 2018 and highest in 2019. The consequence of this is the mid-point value between our reference year (2018) and 2025 is lower than if 2019 had been used. The result of this is that the target QC/ATM and therefore the overall ANQ is lower than if 2019 had been used for the reference year (or 2016-17).
- **QC/ATM as the mechanism of reduction**
  - The basis of the proposed NQS is to promote use of quieter aircraft during the night.
  - By targeting a reduction of QC/ATM airlines are encouraged to use quieter aircraft by enabling additional movement (within the context of other planning constraints). If the targeted reduction QC/ATM is not achieved, then there is an inherent limit placed on the number of movements. As the target QC/ATM reduces over time (across a review period to be defined) further control is added.
  - The mechanism for potential reduction should Incentivise continued modernisation and target reductions in QC/ATM. For example, a future review could propose a reduction of the QC/ATM, and consequent ANQ, that could be considered for implementation in the next 5-year period and then so on every 5 years.
  - An advance target reduction of QC/ATM could be agreed through consultation as a guiding principle to enable advance planning, with a need for this reviewed considering the NAO and EU598.

Section 5: Implementation and management of the Night Quota System (NQS)

This section provides provides draft outline implementation proposals developed by daa. These will be finalised in advance of the ANQ coming into place should the Relevant Action application be granted permission.

The proposed Night Quota System (NQS) for Dublin Airport will be consistent with the Night Flying Restrictions which have been implemented in London. For the purpose of this, daa have based the implementation and administration on the use of the Night Quota at Stansted Airport.

Dublin Airport has and will continue to engage with relevant stakeholders such as the Commission for Aviation Regulation (CAR) and ACL regarding the implementation and administration of the NQS. Existing discussion suggested that the best system to model the proposal for Dublin Airport is the Stansted Night Flying Restrictions, there is still potential for the Dublin Airport NQS to evolve.

Implementation (1)

- The proposed Night Quota System (NQS) for Dublin Airport will be in line with the Night Flying Restrictions which have been implemented in London. For the purpose of this, Dublin Airport have based the implementation and administration on the use of the Night Quota in Stansted Airport. Specifically considered are:
  - Management organisation and slot coordination
  - Overall outline
  - Allocation of quota for historic night flights
  - A Pool Quota
  - Quota exhaustion
  - Carry-over and over-run
  - Dispensation
- **Management and coordination**
  - Airport Coordination Ltd (ACL) are the slot coordinators of both Stansted and Dublin Airports. ACL are the administrators of the equivalent NQS at Stansted and are responsible for:
    - Allocating Night Quota planner operations;
    - Determining and promulgating Night Quota allocation to operations;
    - All applications for Night Quota are handled by ACL;
    - ACL also monitor the Operators' performance against the planned schedule;
    - ACL undertake reviews of the Night Quota allocation.
  - As ACL are the slot coordinators at Dublin Airport, there is precedent for the implementation and administration of this NQS. It would not require wholesale changes to the way that they currently manage the Night Flying Restrictions in London.
- **Outline of the proposed NQS for Dublin Airport:**
  - The Annual Night Quota (ANQ) would be a single annual limit, which will then be broken down to seasonal limits starting with Winter (Nov-Mar) each year. Seasonal Night Quota limits would then be set at the start of each season.
  - A local rule will be implemented for Dublin Airport, which will set out the procedures for allocating and managing the use of the Night Quota in accordance with the NQS.
  - The initial Night Quota allocation would be based on historic slots.
  - The Night Quota Period (NQP) proposed is 23:30 to 06:00, which is consistent with airports operating similar systems.
    - Note that times presented above are on runway times, which differ to block times. The Night Planning Period (NPP) includes block times plus taxi times to ensure that only those movements on the runway in the NQP are considered – this is consistent with considerations for development of the ANQ.

Implementation (2)

- **Allocation of Historic Night Quota:**
  - An air carrier that was allocated a series of Night Slots from the historic allocation shall be entitled to retain the associated Night Quota in the next equivalent season subject to the 80/20 use it or lose it rule (Article 10(2) of the Slot Regulation)
- **Pool Unallocated Night Quota:**
  - The Coordinator (ACL) shall create a pool containing Night Quota not claimed on the initial allocation of the Night Quota. The pool shall contain all Night Quota permitted for the season, including any unused Night Quota carried over from the previous season.
  - 10% of available movements and QC will be held back and the remaining Night Quota shall be allocated in accordance with the Slot Regulation.
- **Allocation of Night Quota from the Pool:**
  - Requests to operate night slots with a different (noisier) aircraft type are subject to confirmation by the Coordinator and the allocation of additional Night Quota, if available.
  - The pool can be used for operations that do not have a Night Quota allocation for ad-hoc flights in the Night Quota Period or for an ad-hoc aircraft substitution for a service normally operated by a noise exempt aircraft
  - If exhaustion of the pool is predicted by the end of the year, requests for an allocation of Night Quota from the pool will be refused to protect planned night flights.
  - Use of Night Quota from the pool is on a non-historic basis only.
- **Exhaustion of Night Quota:**
  - Individual Carrier Night Quota: Air carriers with an allocation of Night Quota must manage their operations within their allocation. If excess use is predicted:
    - Air carriers must obtain supplementary allocation of Night Quota from the pool or if that is not possible, the Coordinator will request voluntary return of Night Quota from operators
  - Airport Night Quota: If the airport, as a whole, is predicted to exceed the amount of Night Quota available for the year, appropriate corrective actions need to be taken:
    - The allocation of new Night Slots, including ad-hoc slots, may be suspended;
    - The approval of unplanned use of Night Quota from the pool may be rationed or suspended;
    - Air carriers holding more Night Quota than required for their planned operations may be required to return the excess Quota;
    - Air carriers without an allocation of Night Quota that have used a significant amount from the pool may be prohibited from further use of Night Quota;
    - Air carriers that have exhausted their allocation of Night Quota may be prohibited from further use of Night Quota.

Implementation (3)

- **Carry-over and overrun arrangements:**
  - Carry-over and overrun arrangements give the airport flexibility to defer or bring forward movements and quota allowance from one year to the next. The following are the proposed carry-over and overrun provisions:
    - If required, a shortfall in use of noise quota in one year of up to 10% may be carried over to the next year;
    - Conversely, up to 10% of an overrun in noise quota usage in one year (not being covered by carryover from the previous year) will be deducted from the corresponding allocation in the following year;
    - An overrun of more than 10% will result in a deduction of 10% plus twice the amount of the excess over 10% from the corresponding allocation in the following year;
    - The absolute maximum overrun is 20% of the original limit in each case.

- **Night Flight Dispensation:**
  - It is proposed to follow the UK Department for Transport's (DfT) guidance on night flight dispensation[1].
  - The DfT allows airport operators to disregard certain movements, providing they meet specified criterion. Any movements that are granted a dispensation in this way do not count towards an airport's movements of Quota Count allowance.
  - There are four type of circumstances that currently allow operators to grant dispensations, which are set out in the guidance[2]:
    - Emergencies;
    - Widespread and prolonged air traffic disruption;
    - Delays as a result of disruption leading to serious hardship and congestion at the airfield or terminal;
    - The Secretary of State can also grand dispensations with where movements relate to matters of the state.

Notes:

1. Night flights restrictions at Heathrow, Gatwick and Stansted airports beyond 2024, plus national night flight policy - GOV.UK (www.gov.uk)

2. Annex F: Guidelines on Dispensations (publishing.service.gov.uk)

Section 6: Calculating the proposed 6.5h Annual Night Quota

A 4-step process was developed for the December 2020 based on targeting a reduction in QC/ATM in 2025 compared with 2018.

Based on the schedules used for the Relevant Action Application the QC/ATM was calculated for 2018 (based on actual movement data) and 2025 (based on the forecast). Forecasts are inherently uncertain and so daa proposed that a target QC/ATM for 2025 mid-way between the values of 2018 and 2025 be adopted. A QC/ATM approach was adopted to promote use of quieter aircraft.

This process and calculation is summarised in this section for the proposed Annual Night Quota of 7,990 for the period 23:30 to 06:00 (the Night Quota Period).

Proposed 4 step process for calculating the Annual Night Quota

1 Determine Typical aircraft QC values

- QC values of aircraft types operating at Dublin Airport have been determined.
- Future aircraft types to 2025 are all known currently.
- Process for allocating QC values to aircraft types, for both historic and forecast, is based on a lookup table with one set of QC values associated with each aircraft type derived from the existing system in use at the UK London Airports.
- See Annex B for QC values for each aircraft type.

2 Calculate NQP QC Total & QC/ATM

- Using QC values from step 1, Total QC and QC/ATM calculated for each year.
- Historic Actual: 2018, 2019
- Forecast years: 2022-2025

Note: Actuals contain flights not scheduled to operate during the NQP (eg late departures/arrivals and early arrivals and unscheduled ATMs).The forecast does not include such flights and assumes on-time operation.

3 Determine QC/ATM Target value

- The objective is to deliver a reduction of average fleet noise per movement (QC/ATM) in 2025 compared to 2018.
- In 2025, target QC/ATM to be <2018 and no greater than 2022.
- Derive the mid-value of QC/ATM between 2018 and 2025.

4 Annual Night Quota (ANQ) 2022-2025

- Apply the target QC/ATM, derived from step 3, to the total number of ATMs forecast in 2025 to determine an Annual Night Quota to be used for the period 2022-2025 for scheduled ATMs.

Note: The ANQ derived at this stage would only apply to forecast scheduled and non-scheduled ATMs. Additional consideration will be required for late operations in the NQP (flights scheduled before 23:30 but have been found on-occasion to operate after 23:30.
A tolerance is needed to allow for variability inherent in forecasts.

Proposed Annual Night Quota for 6.5h Night Quota Period

The December 2020 Application, proposed an **ANQ(6.5h) of 7,990**.

1 Determine Typical aircraft QC values

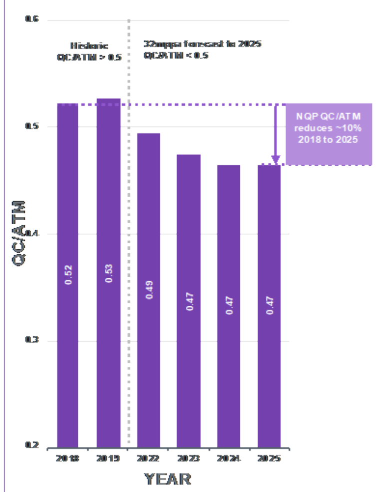
- QC values of aircraft types operating at Dublin Airport have been determined and examples presented below. The full reference table is presented in Annex B
- Future aircraft types to 2025 are all known currently.
- Typical QC values

Current type				Replacement type		
A320CEO				**A320NEO**		
	Arrival:	0.25	→		Arrival:	0.125
	Departure:	0.5			Departure:	0.25
737-800				**737-800 Max**		
	Arrival:	0.5	→		Arrival:	0.25
	Departure:	0.5			Departure:	0.25
A330-300				**A350-900**		
	Arrival:	0.5	→		Arrival:	0.5
	Departure:	2			Departure:	0.5
B767-300				**B787-900**		
	Arrival:	1	→		Arrival:	0.5
	Departure:	2			Departure:	1

- The forecast schedules and assigned QC values for each movement are provided in the ANCA Reporting Template.

2 Calculate NQP QC Total & QC/ATM

- Using QC values from step 1, Total QC and QC/ATM calculated for each year.
- Historic Actual: 2018, 2019
- Forecast years: 2022-2025



3 Determine QC/ATM Target value

- The objective is to deliver a reduction of average fleet noise per movement (QC/ATM) in 2025 compared to 2018.
- In 2025, QC/ATM to be <2018 and no greater than 2022.
- Derive the mid-value of QC/ATM between 2018 and 2025. Must be no greater than 2022.

QC/ATM Target = 0.49

Note: Analysis of the historic QC/ATM suggests that 2018 had the lowest QC/ATM in the period 2016-19. According to the defined process for generating target QC/ATM this would serve to lower the target QC/ATM for 2025 and so reduce the proposed ANQ compared with if 2019 had been used. (see later)

4 Annual Night Quota 6.5h (ANQ) 2022-2025

- Apply the QC/ATM, derived from step 3, to the total number of ATMs forecast in 2025 to determine an Annual Night Quota to be used for the period 2022-2025 for scheduled ATMs.
- This will apply to the newly developed forecasts.

ANQ = 7,990
2022-2025

Note: The ANQ derived at this stage would only apply to forecast scheduled and non-scheduled ATMs. Additional consideration will be required for late operations in the NQP (flights scheduled before 23:30 but have been found on-occasion to operate after 23:30. A tolerance is needed to allow for variability inherent in forecasts.

Section 7:
ANQ Performance.
6.5h Night Quota Period 23:30-06:00
Revised Forecasts.

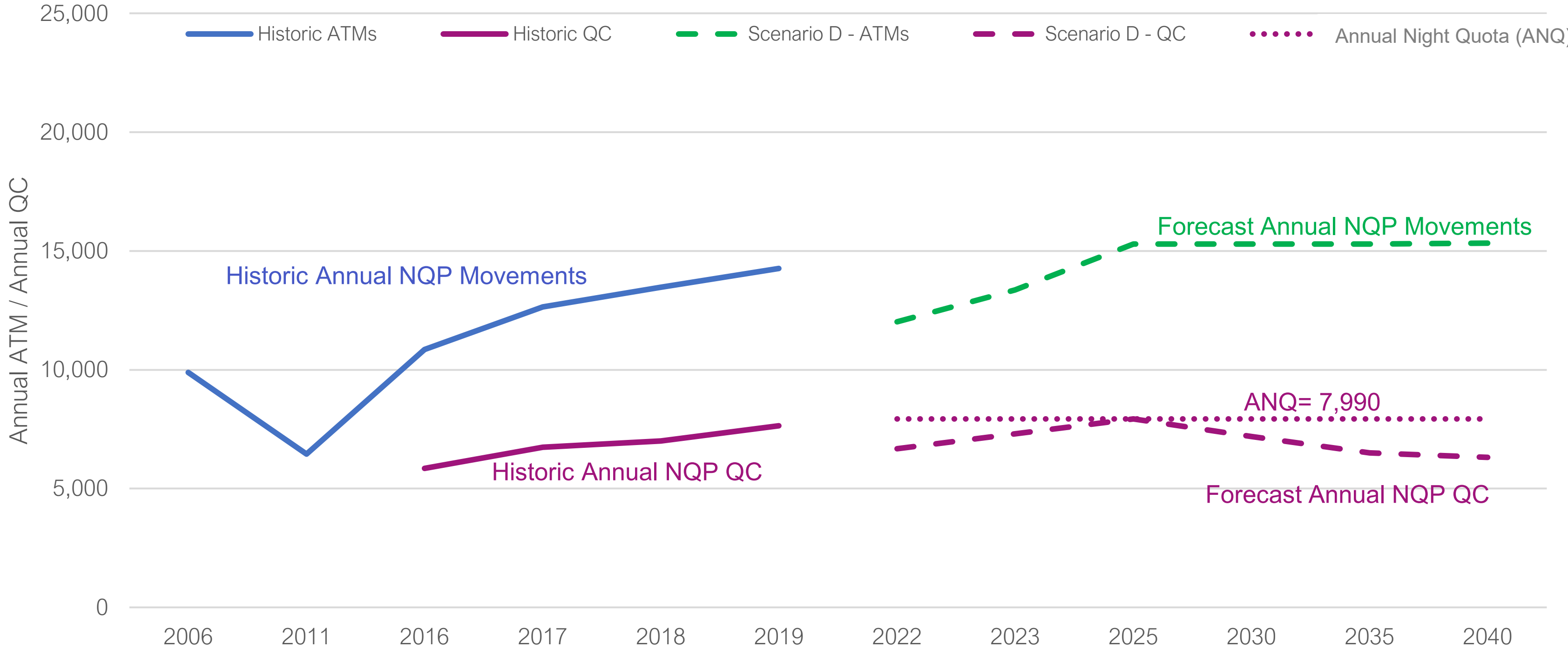
The next slides present the performance of the two revised forecasts scenarios: the first with the 32 million passengers cap remaining in place beyond 2025 (Scenario D) and a growth forecast where the 32 million passengers is lifted beyond 2025 (Scenario A).

These are compared with the proposed ANQ of 7,990 as previously submitted with a 6.5h NQP. Historic QC for 2016-2019 are also presented.

The data underpinning this analysis is included in the ANCA reporting template.

6.5h Night Quota Period Annual Night Quota – Movements and QC

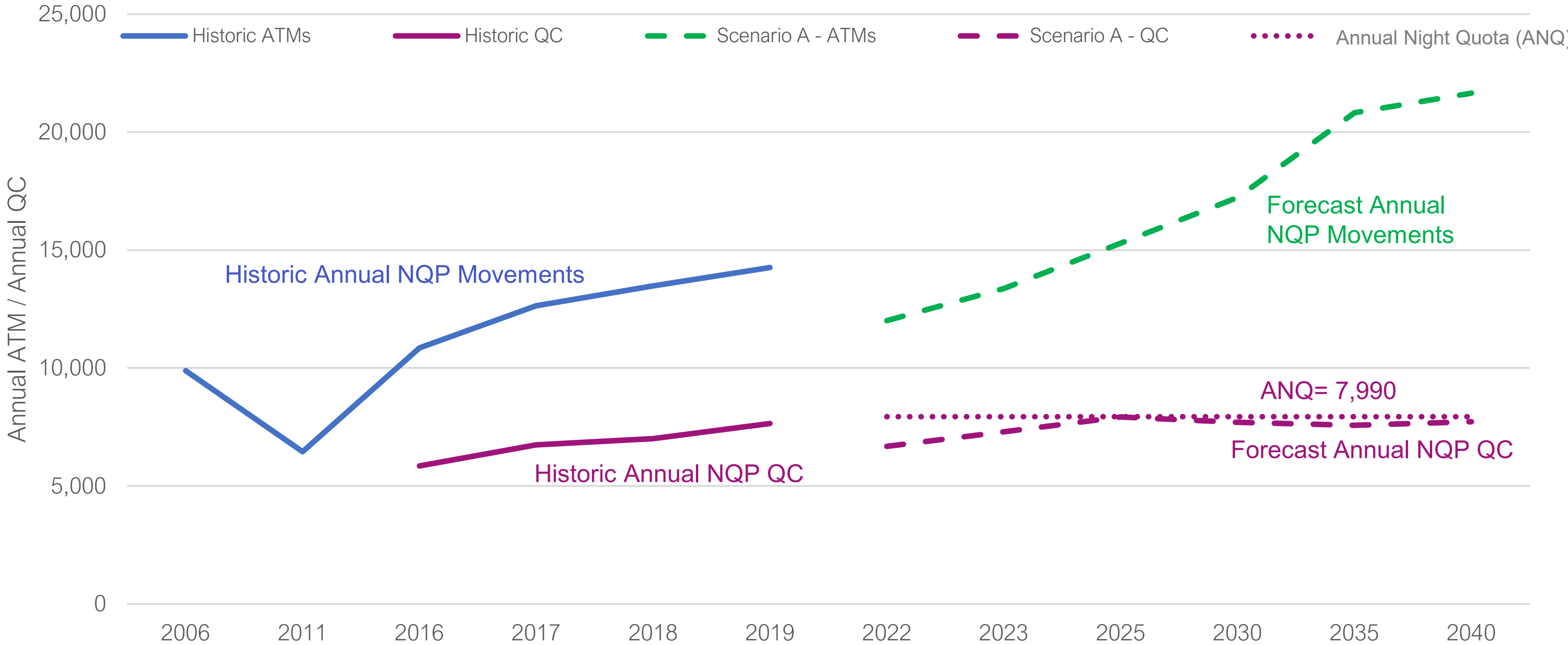
Relevant Action (32 million passengers cap in place beyond 2025)



	Actuals						Scenario D – 32mppa					
Year	**2006**	**2011**	**2016**	**2017**	**2018**	**2019**	**2022**	**2023**	**2025**	**2030**	**2035**	**2040**
ATMs	9,892	6,450	10,850	12,641	13,479	14,263	12,016	13,362	15,292	15,292	15,292	15,334
QC			5,857	6,741	7,004	7,650	6,684	7,302	7,931	7,198	6,507	6,321
ANQ							7,990					
QC headroom							-16%	-8%	<1%	-9%	-18%	-20%

6.5h Night Quota Period Annual Night Quota – Movements and QC

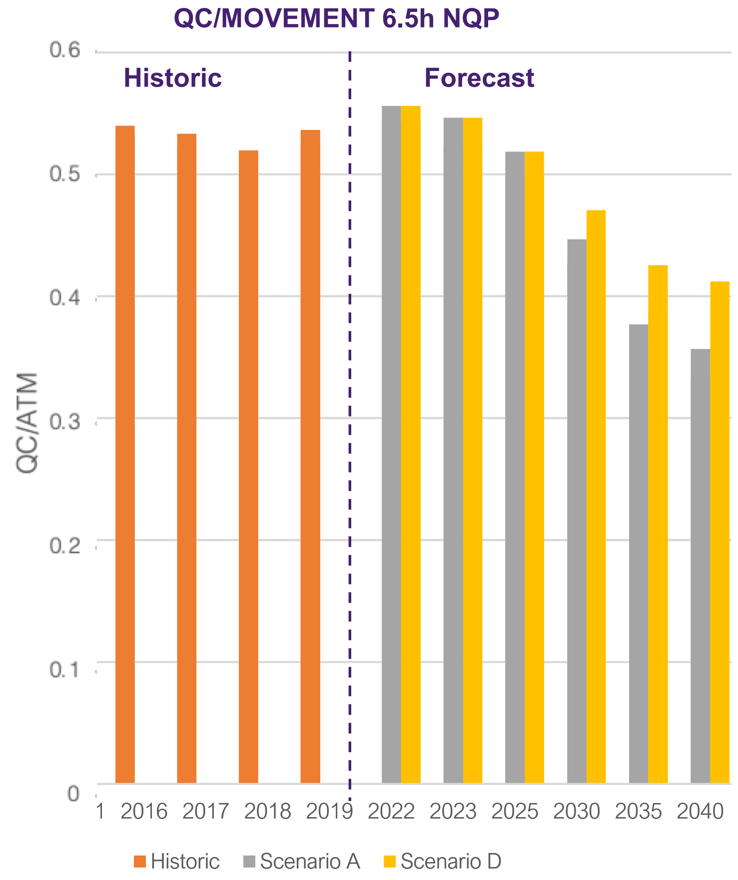
Growth scenario (with 32mppa cap removed beyond 2025)



	Actuals						Scenario A - Growth					
Year	**2006**	**2011**	**2016**	**2017**	**2018**	**2019**	**2022**	**2023**	**2025**	**2030**	**2035**	**2040**
ATMs	9,892	6,450	10,850	12,641	13,479	14,263	12,016	13,362	15,292	17,227	20,823	21,651
QC			5,857	6,741	7,004	7,650	6,684	7,302	7,931	7,696	7,575	7,727
ANQ							7,990					
QC headroom							-16%	-8%	0%	-3%	-5%	-3%

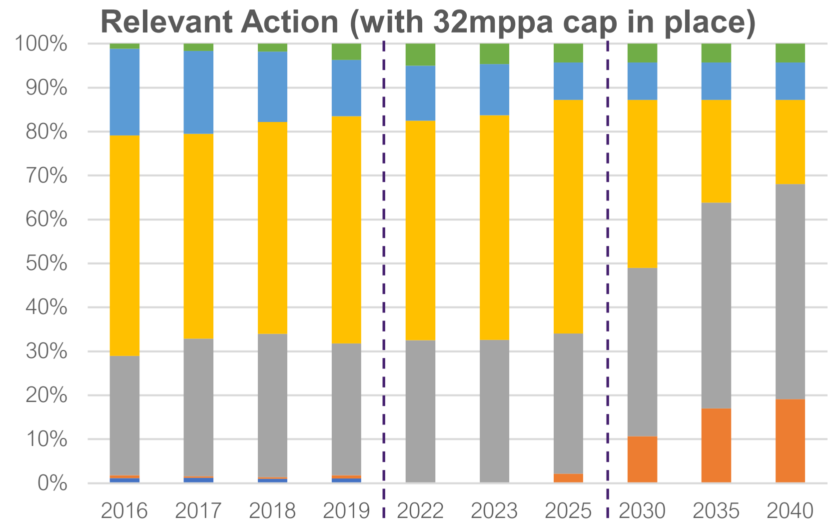
ANQ controls movements whilst limiting QC noise output

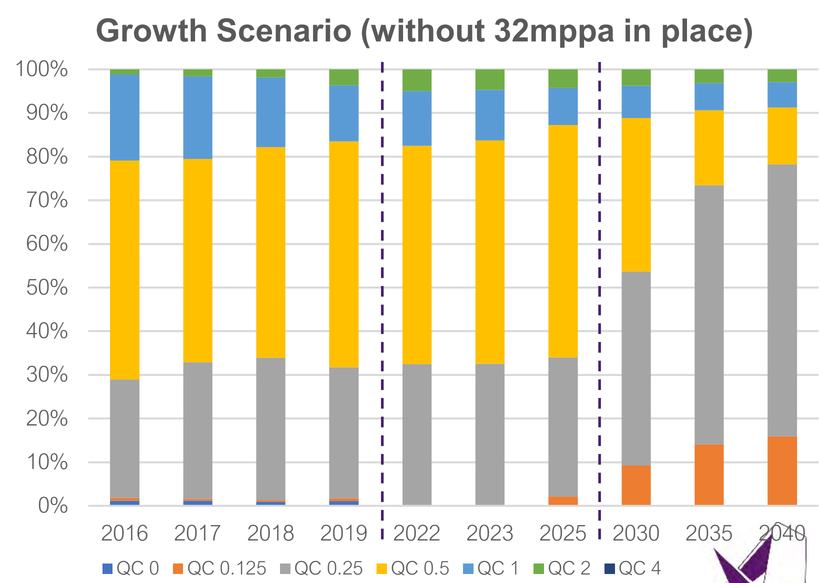
- The evolution of QC/movement is shown in the figure to the right. This shows a continuous reduction for both scenarios from 2022 as the fleet modernises. Both scenarios are the same to 2025 - QC per movement forecast to be less than 2018.
- Beyond 2025 the QC per movement shows continued reduction in both scenarios but greater without the 32mppa cap in place (Scenario A) with QC/ATM forecast to be lower than the Relevant Action scenario with the 32 mppa cap in place (Scenario D). This is as a result growth being delivered through use of quieter aircraft (see next slide for comparison of proportion of movements by QC).
- The original proposal for an ANQ of 7,990 was based on a target QC/ATM that was the mid-point between the value derived from actual movements in 2018 (0.52) and that forecast for 2025 (0.48) -> target QC/ATM 0.49. This approach provided a tolerance of QC use in 2025 to allow for the uncertainty inherent in forecasts.
- Reflecting uncertainty in post-pandemic recovery, the original application forecasts have been revised. In the period 2022-2025 6.5h NQP movements are reduced compared to the December 2020 Application forecasts.
- Whilst the revised forecasts indicate fewer movements than used for the December 2020 analysis, a higher total QC is forecast, resulting in a higher QC/ATM. (see figure to the right). Consequently, as presented in previous slides in this section, the higher total QC use takes up most of the tolerance proposed in the application documentation submitted in December 2020.
- The revised forecasts indicate a forecast QC/ATM of 0.51 – this is less than 2018 but higher than the target. With QC/ATM being higher than the target, fewer movements are possible to stay within the ANQ which illustrates how the proposed approach can control movements whilst controlling noise output.



Movements by QC in the 6.5h NQP

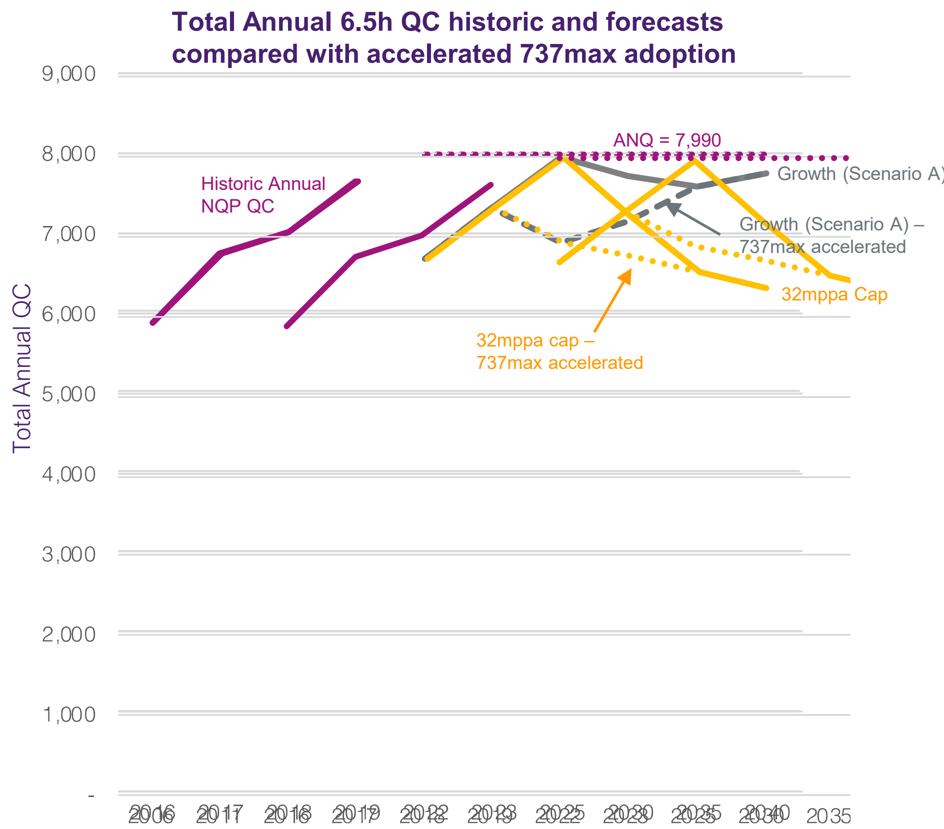
- The two figures present the proportion of movements by each QC band for each year considered.
- These figures indicates that in the period 2022-2025 the proportion of movements by QC0.5 or lower increases. This is driven by QC0.5 and QC0.125 increases, with a coincident reduction in the proportion of QC1 movements. The proportion of aircraft QC0.5 or lower increases compared with 2018 across this period. Both scenarios are the same to 2025.
- With the Relevant Action scenario, beyond 2025 the proportion of movements by aircraft QC 0.5 or lower remains similar to 2025. However, the proportion of movements by QC 0.5 decreases as the proportion by QC 0.25 or lower increases. There is a significant increase in the proportion of QC0.25 and QC0.125. QC1 and QC2 remain broadly the same to 2040 (this reflects conservative assumptions relating to source noise reductions in the future).
- Beyond 2025, the Growth scenario is driven by increasing proportions of QC0.25 aircraft. This serves to reduce the QC/ATM as indicated in the previous slides in this scenario compared with the Relevant Action scenario. The transition to QC0.25 movements comes at the expense of QC0.5 aircraft.





Sensitivity of the 6.5h Annual Night Quota to complete adoption of 737max aircraft by Ryanair in 2025

- The figure presents the Total Annual QC use as per forecast for the Relevant Action with 32mppa cap in place (Scenario D) and Growth (Scenario A) scenarios and the equivalent values if the 737max full adoption in 2025. All years up to 2025 are the same, with remaining 737max aircraft all adopted in that year.
- Both of the 737 max sensitivities are the same for the period to 2025 and indicate a significant reduction of Total Annual QC compared to the slower and more conservative rate of adoption presented in the forecasts.
- Beyond 2025 the Total Annual QC continues to fall with Scenario D as the number of movements remains held by the passenger constraint and further quieter aircraft are introduced into the fleet.
- With Scenario A, the Total Annual QC begins to rise after 2025 as the number of movements rises.
- By 2035 both scenarios have returned to where they would be with the forecasts without accelerated 737max adoption.



Section 8: Calculating an 8h equivalent Annual Noise Quota

The same 4 step process used to develop the 6.5h ANQ has been used to derive an 8h equivalent Annual Night Quota (ANQ(8h)).

The ANQ(8h) has been calculated using the revised Relevant Action with the 32mppa cap in place scenario (Scenario D) for 2025.

daa is providing this analysis for information purposes and it should not be considered an alternative proposal.

The same 4-step process has been used to calculating an equivalent Annual Night Quota for an 8h Night Quota Period

1 Determine Typical aircraft QC values	2 Calculate NQP QC Total & QC/ATM	3 Determine QC/ATM Target value	4 Annual Night Quota (ANQ) 2022-2025
▪ QC values of aircraft types operating at Dublin Airport have been determined. ▪ Future aircraft types to 2025 are all known currently. ▪ Process for allocating QC values to aircraft types, for both historic and forecast, is based on a lookup table with one set of QC values associated with each aircraft type derived from the existing system in use at the UK London Airports. ▪ See Annex B for QC values for each aircraft type.	▪ Using QC values from step 1, Total QC and QC/ATM calculated for each year. ▪ Historic Actual: 2018, 2019 ▪ Forecast years: 2022-2025 **Note**: Actuals contain flights not scheduled to operate during the NQP (eg late departures/arrivals and early arrivals and unscheduled ATMs).The forecast does not include such flights and assumes on-time operation.	▪ The objective is to deliver a reduction of average fleet noise per movement (QC/ATM) in 2025 compared to 2018. ▪ In 2025, target QC/ATM to be <2018 and no greater than 2022. ▪ Derive the mid-value of QC/ATM between 2018 and 2025.	▪ Apply the target QC/ATM, derived from step 3, to the total number of ATMs forecast in 2025 to determine an Annual Night Quota to be used for the period 2022-2025 for scheduled ATMs. **Note**: The ANQ derived at this stage relates to forecast scheduled and non-scheduled ATMs. Additional consideration will be required for late operations in the NQP (flights scheduled before 23:00 but have been found on-occasion to operate after 23:00. A tolerance is needed to allow for variability inherent in forecasts.

1 Typical Aircraft Type QC Values

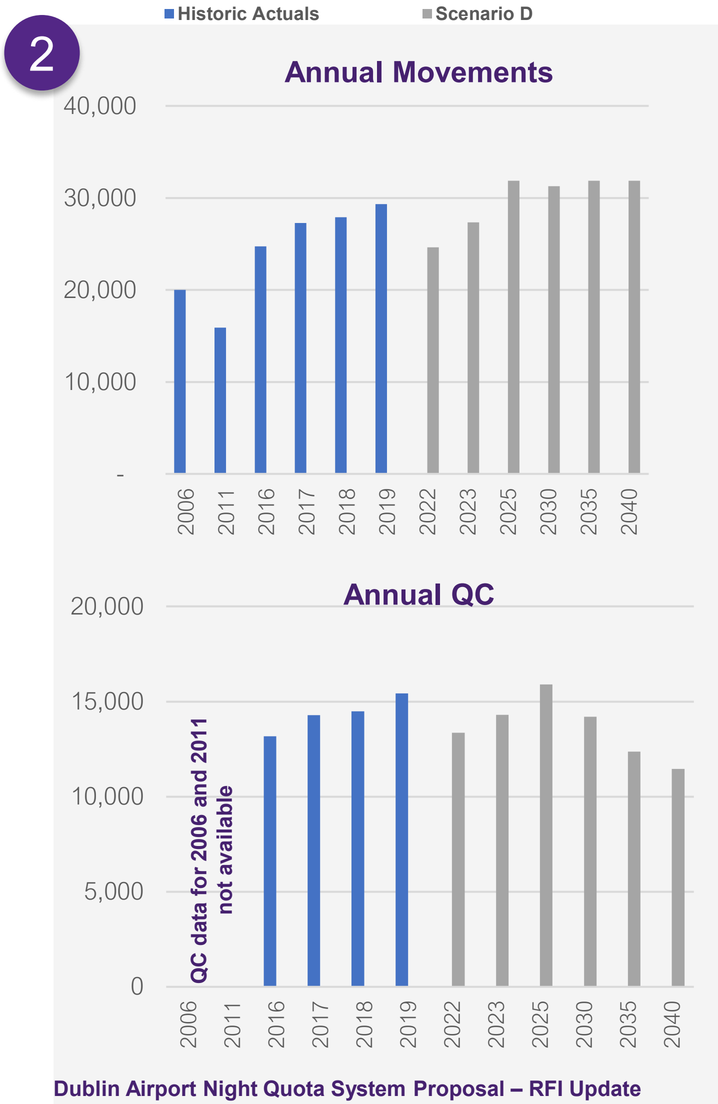
Process for allocating QC values to aircraft types, for both historic and forecast, is based on a lookup table with one set of QC values associated with each aircraft type derived from the existing system in use at the UK London Airports.

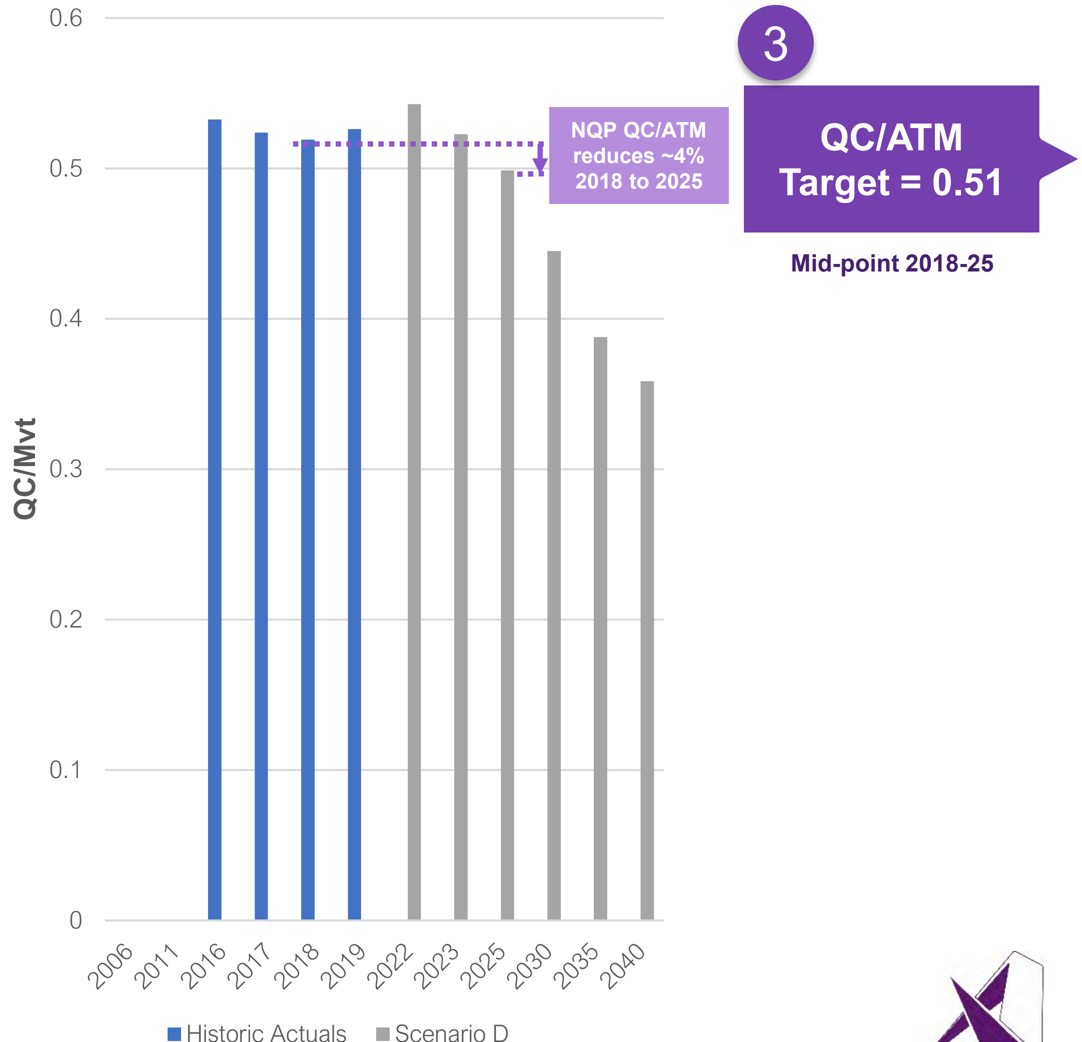
Examples presented below - see Annex B for full list .

Current type			Replacement type		
A320CEO			**A320NEO**		
	Arrival:	0.25	→	Arrival:	0.125
	Departure:	0.5		Departure:	0.25
737-800			**737-800 Max**		
	Arrival:	0.5	→	Arrival:	0.25
	Departure:	0.5		Departure:	0.25
A330-300			**A350-900**		
	Arrival:	0.5	→	Arrival:	0.5
	Departure:	2		Departure:	0.5
B767-300			**B787-900**		
	Arrival:	1	→	Arrival:	0.5
	Departure:	2		Departure:	1

2 Calculate NQP QC Total and QC/ATM and 3 QC/ATM Target

Based on historic 2018 and revised Relevant Action 32 million passengers cap scenario (Scenario D)





Annual Night Quota for 8h equivalent Night Quota Period

Based on revised Relevant Action 32mppa cap remaining in place scenario (scenario D) ANQ(8h) of 16,260 has been calculated.

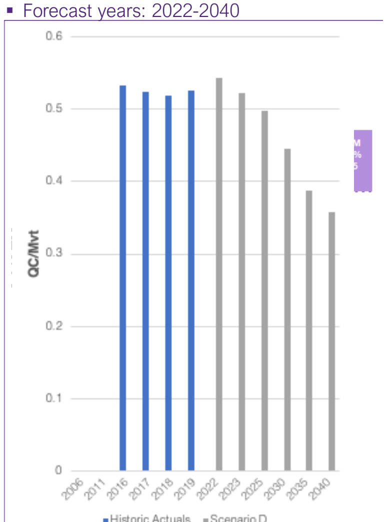
1 Determine Typical aircraft QC values

- QC values of aircraft types operating at Dublin Airport have been determined. See Annex B
- Future aircraft types to 2025 are all known currently.

Current type		Replacement type	
A320CEO		**A320NEO**	
Arrival:	0.25	Arrival:	0.125
Departure:	0.5	Departure:	0.25
737-800		**737-800 Max**	
Arrival:	0.5	Arrival:	0.25
Departure:	0.5	Departure:	0.25
A330-300		**A350-900**	
Arrival:	0.5	Arrival:	0.5
Departure:	2	Departure:	0.5
B767-300		**B787-900**	
Arrival:	1	Arrival:	0.5
Departure:	2	Departure:	1

2 Calculate NQP QC Total & QC/ATM

- Using QC values from step 1, Total QC and QC/ATM calculated for each year.
- Historic Actual: 2018, 2019
- Forecast years: 2022-2040



3 Determine QC/ATM Target value

- The objective is to deliver a reduction of average fleet noise per movement (QC/ATM) in 2025 compared to 2018.
- In 2025, QC/ATM to be <2018 and no greater than 2022.
- Derive the mid-value of QC/ATM between 2018 and 2025. Must be no greater than 2022.

QC/ATM Target = 0.51

4 Annual Night Quota 8H Equivalent (ANQ8h) 2022-2025

- Apply the QC/ATM, derived from step 3, to the total number of ATMs forecast in 2025 to determine an Annual Night Quota(8h) to be used for the period 2022-2025 for scheduled ATMs.
- This will apply to the newly developed forecasts.

ANQ(8h) = 16,260
2022-2025

Note: The ANQ derived at this stage would only apply to forecast scheduled and non-scheduled ATMs. Additional consideration will be required for late operations (flights scheduled before 23:00 but have been found on-occasion to operate after 23:00. A tolerance is needed to allow for variability inherent in forecasts.

Section 9:
ANQ performance.
8h Night Quota Period 23:00-07:00
Revised Forecasts

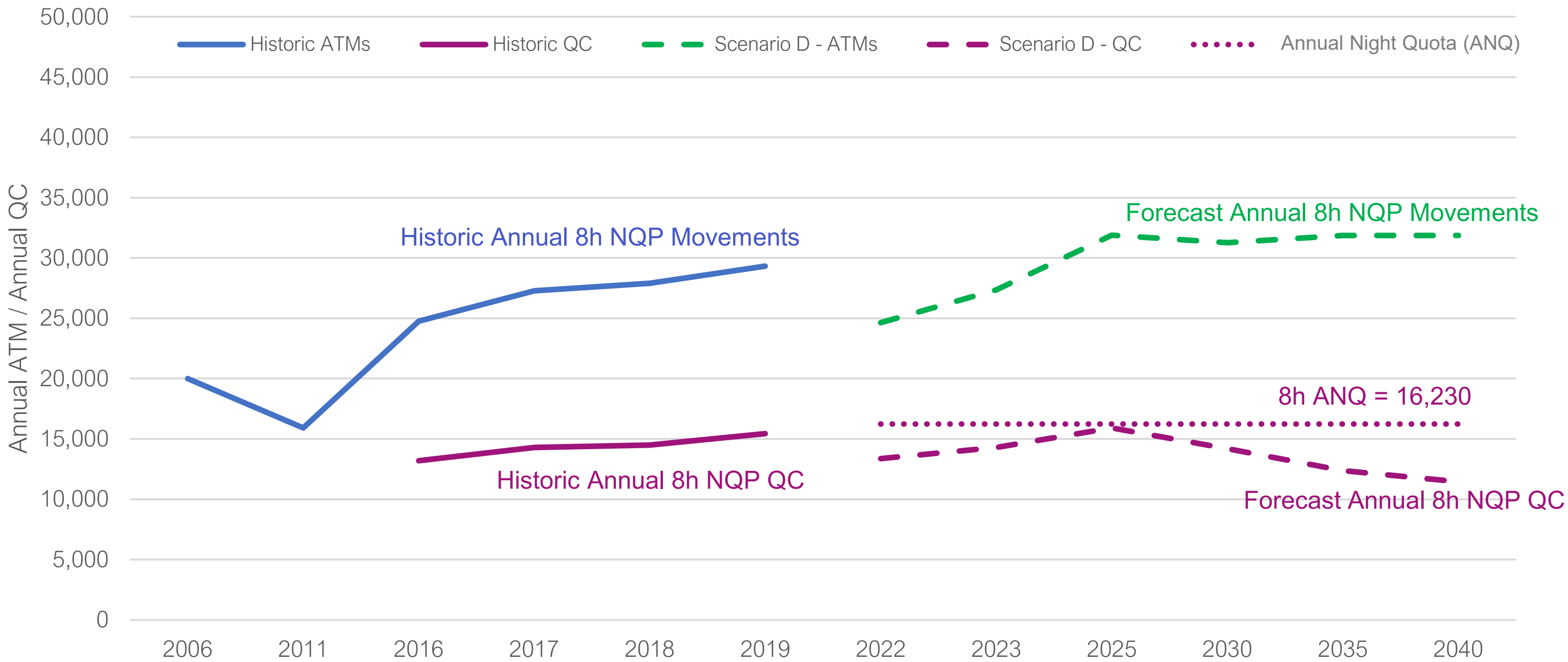
The next slides present the performance of the revised Relevant Action with the 32mppa cap in place (Scenario D) and Growth Scenarios with respect to an equivalent 8h ANQ of 16,230 as derived in Section 8.

Historic QC for 2016-19 are presented for the same 8h period.

The data underpinning this presentation is included in the ANCA reporting template.

8h Night Quota Period Annual Night Quota – Movements and QC

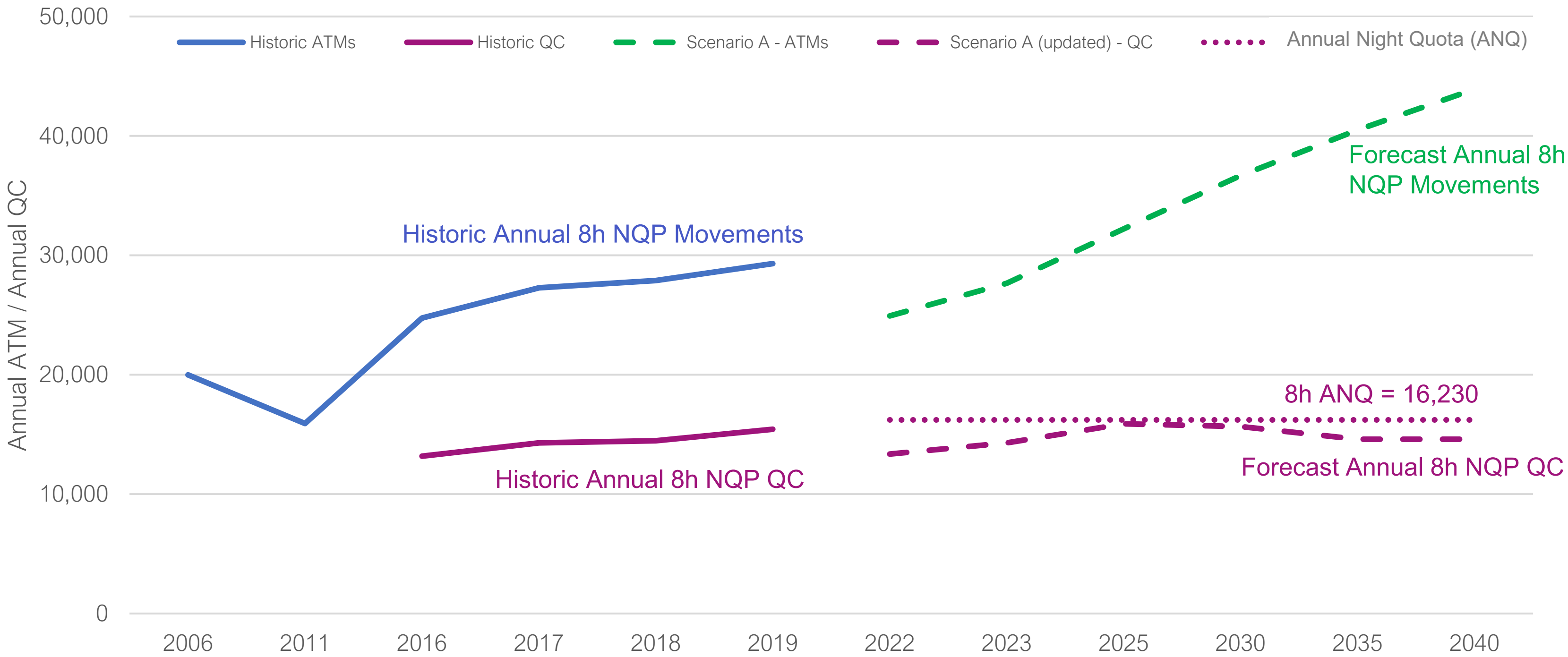
Relevant Action (32 million passengers cap in place beyond 2025)



	Actuals						Scenario D					
Year	**2006**	**2011**	**2016**	**2017**	**2018**	**2019**	**2022**	**2023**	**2025**	**2030**	**2035**	**2040**
8h ATMs	19,995	15,917	24,756	27,283	2,7896	29,319	24,633	27,345	31,885	31,264	31,866	31,866
8h QC			13,182	14,289	14,484	15,426	13,368	14,294	15,902	14,194	12,363	11,459
8h ANQ							16,260					
QC tolerance							-18%	-12%	-2%	-13%	-24%	-29%

8h Night Quota Period Annual Night Quota – Movements and QC

Growth scenario (with 32mppa cap removed beyond 2025)

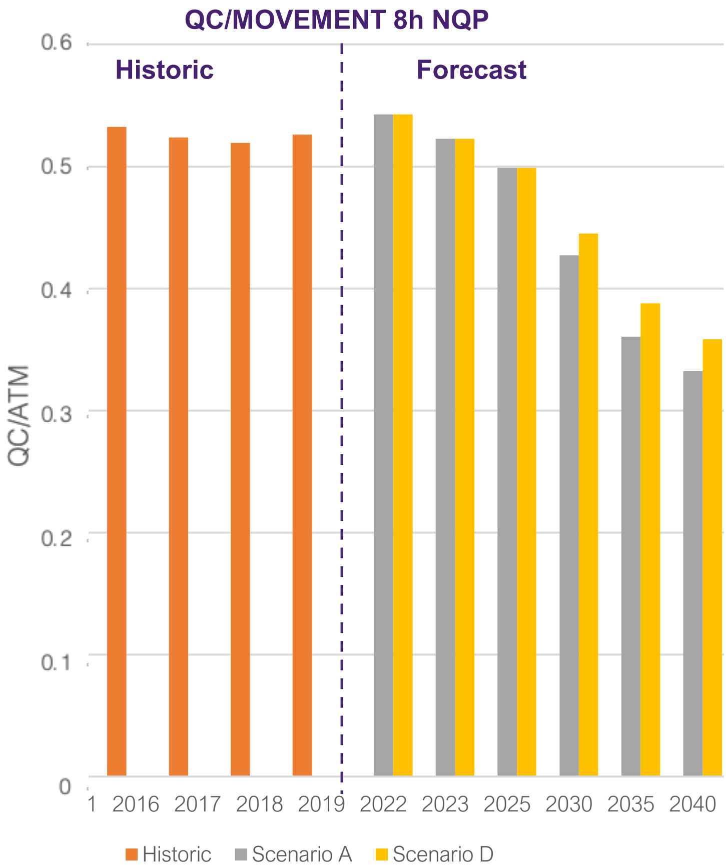


	Actuals						Scenario A					
Year	2006	2011	2016	2017	2018	2019	2022	2023	2025	2030	2035	2040
8h ATMs	19,995	15,917	24,756	27,283	2,7896	29,319	24,633	27,345	31,885	36,688	40,506	43,929
8h QC			13,182	14,289	14,484	15,426	13,368	14,294	15,902	15,672	14,601	14,591
8h ANQ							16,260					
QC tolerance							-18%	-14%	-2%	-3%	-10%	-10%

QC per movement. 8h NQP

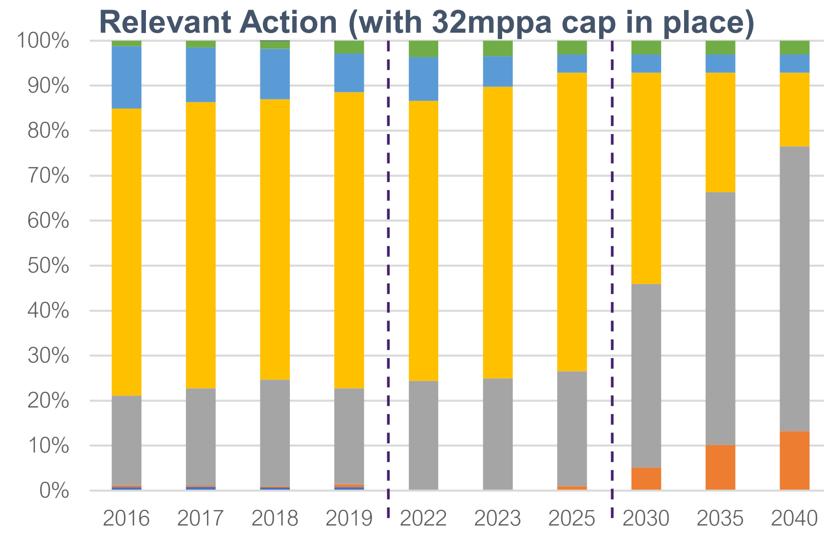
Relevant Action (32 million passengers cap in place beyond 2025) (Scenario D) and Growth scenario (with 32mppa cap removed beyond 2025) (Scenario A)

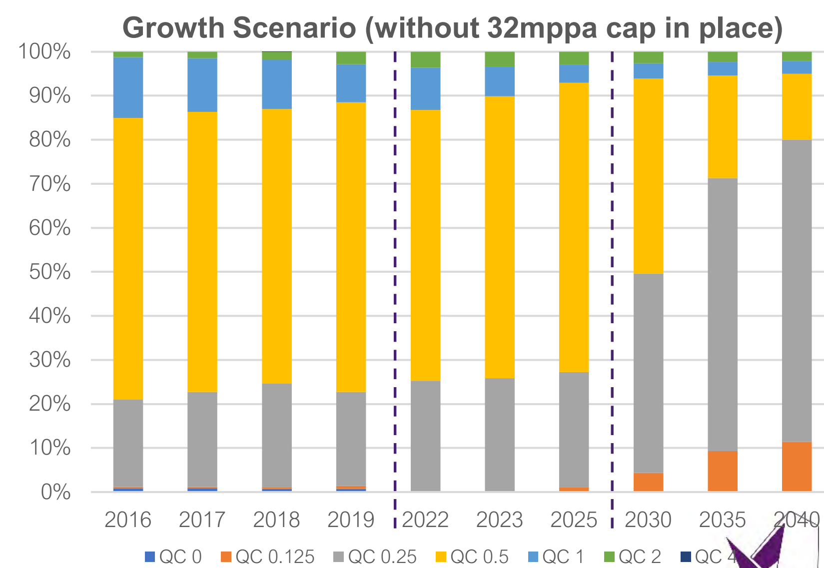
- The trend of QC/ATM for the 8h equivalent NQP is similar to that of the 6.5h presented in section 7 with a continuous reduction for both scenarios from 2022 as the fleet modernises.
- Both scenarios are the same to 2025, with the QC per movement forecast forecast to be ~0.5 for both scenarios. This is less than 2018 and follows the trend of reduction of QC/ATM from opening year.
- Beyond 2025 the QC per movement shows continued reduction in both scenarios but accelerated for the growth scenario with the 32mppa cap removed (Scenario A) with QC/ATM forecast to be lower than the Relevant Action with the 32mppa cap in place scenario (Scenario D). This is explained by the growth being delivered through use of quieter aircraft (see next slide for comparison of proportion of movements by QC value).
- By 2030 the QC/ATM across the 8h period is forecast to be approaching 0.4 and subsequently being less than 0.4 by 2035.



Movements by QC in the 8h equivalent NQP

- The two figures present the proportion of movements by each QC band for each year considered for the 8h equivalent NQP. They show the same broad trends as for the 6.5h NQP presented in Section 8.
- In the period 2022-2025 both scenarios are the same. The proportion of movements by QC0.5 or lower increases to greater than 90%, driven mostly by QC0.5. The proportion of aircraft QC0.5 or lower increases compared with 2018 across this period.
- With the revised Relevant Action (32mppa cap remaining in place) scenario (D), beyond 2025 the proportion of movements by aircraft QC 0.5 or lower remains broadly similar to 2025. However, the proportion of movements by QC 0.5 decreases as the proportion by QC 0.25 or lower increases. There is a significant increase in the proportion of QC0.25 and QC0.125. QC1 and QC2 remain broadly the same to 2040 (this reflects conservative assumptions relating to source noise reductions in the future).
- Beyond 2025 the Growth scenario (without the 32mppa cap in place) is driven by increasing proportions of QC0.25 aircraft. This serves to reduce the QC/ATM as indicated in the previous slides in this scenario compared with the Relevant Action (32mppa cap in place) scenario. The transition to QC0.25 movements comes at the expense of QC0.5 aircraft.

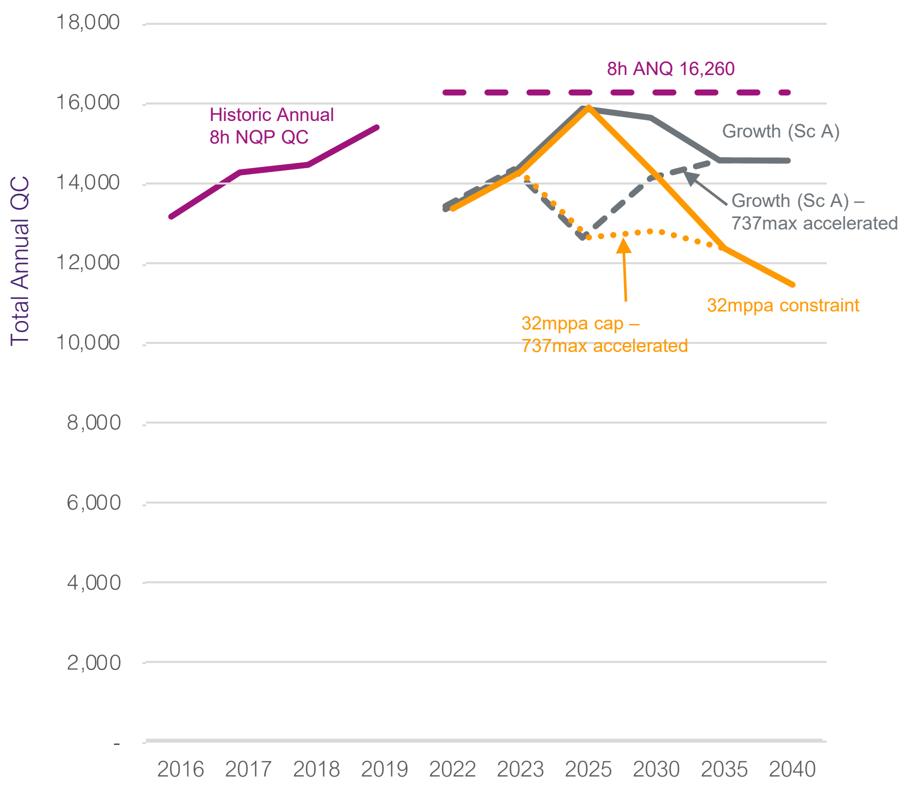




Sensitivity of the 8h equivalent Annual Night Quota to complete adoption of 737max aircraft by Ryanair in 2025

- The figure presents the Total 8h equivalent Annual QC as per forecast for the Relevant Action (with 32mppa cap in place) (Scenario D) and the growth (with the 32mppa cap removed beyond 2025) (Scenario A) scenarios and the equivalent values if the 737max adoption is complete in 2025 - all years up to 2025 are the same, with remaining 737max aircraft all adopted in that year.
- The overall trends are the same for that identified with the 6.5h NQP.
- Both of the 737 max sensitivities are the same for the period to 2025 and indicate a significant reduction of Total Annual QC compared to the slower and more conservative rate of adoption presented in the forecasts.
- Beyond 2025 the Total Annual QC continues to fall with the Relevant Action (with 32mppa cap in place) as the number of movements remains held by the passenger constraint and further quieter aircraft are introduced into the fleet.
- With the Growth scenario (32mppa cap removed beyond 2025) the Total Annual QC begins to rise after 2025 as the number of movements rises.
- By 2035 both scenarios have returned to where they would be with the forecasts without accelerated 737max adoption.

Total Annual 8h QC historic and revised forecasts compared with accelerated 737max adoption



Annex A

Assumptions

Assumptions

- Scaling factors

Year	Scenario	Annual ATMs	Daily ATMs	Forecast busy day ATMs	Ratio (average day/busy)	Busy day to annual Ratio
2022	Scenario A	175736.93	481.5	585	0.82	300.41
2023		207571.48	568.7	668	0.85	310.74
2025		239786.47	656.9	737	0.89	325.35
2030		275954.88	756.0	865	0.87	319.02
2035		298614.25	818.1	951	0.86	314.00
2040		317925.92	871.0	1016	0.86	313.78
2022	Scenario D	175736.93	481.5	585	0.82	300.41
2023		207571.48	568.7	668	0.85	310.74
2025		235882.21	646.3	725	0.89	325.35
2030		235882.21	646.3	725	0.89	325.35
2035		235882.21	646.3	725	0.89	325.35
2040		235882.21	646.3	725	0.89	326.25

- Flights considered to fall within night period when runway time falls between 23:00 and 06:59 (8hrs) or 23:30 and 05:59 (6.5hrs/QC period) .
- Taxi times
  - Arrival – 7 minutes
  - Departures – 16 minutes

- The following flights have been excluded
  - Helicopters (based on ICAO or IATA code) or flights where runway ='HH' (assumed to be erroneous)
  - Military flights (flight class: Military Gen Ops (2006,2011) or W (2016 onwards))

- Historic analysis assumes QC0.25 and 0.125 existed in all years (to ensure a direct comparison of noise levels).
- Aircraft with MTOW <8,618kg do not count towards QC count (but do count towards movements)

Annex B

QC Reference Tables – Forecast and Historic

All QC values based on typical values associated with the QC for aircraft movements used at the UK London Airports

Forecasts QC reference table

Aircraft code	Est QC Arrival	Est QC Departure
223	0.125	0.25
318	0.25	0.25
319	0.25	0.5
320	0.25	0.5
321	0.25	1
332	0.5	2
333	0.5	2
339	0.5	1
359	0.5	0.5
738	0.5	0.5
739	0.5	1
781	0.25	1
788	0.25	0.5
789	0.25	0.5
32A	0.25	0.5
32N	0.125	0.25
32Q	0.25	0.5

Aircraft code	Est QC Arrival	Est QC Departure
33F	0.5	2
738F	0.5	0.5
73H	0.5	0.5
73P	1	1
73W	0.5	0.5
75W	1	1
76F	2	2
76V	1	2
77L	1	2
77W	1	2
7M2	0.25	0.25
7M8	0.25	0.25

Aircraft code	Est QC Arrival	Est QC Departure
ABY	1	2
AT4	0.5	0.125
AT7	0.25	0.25
CNT	0	0
CS3	0.125	0.25
DH4	0.25	0
E70	0.25	0.5
E75	0.25	0.5
E90	0.125	0.5
E92	0.125	0.5
E95	0.125	0.5
ER4	0.125	0.125
GS5	0.125	0.25
Q84	0	0.25
SF3	0.25	0.25

Historic flights QC reference table (1)

Aircraft	Est QC Arrival	Est QC Departure	Notes
Aerospatiale/Alenia ATR 42 300/320	0.25	0.125	Based on -300 variant
ATR 42-320/PW121	0.25	0	
Aerospatiale/Alenia ATR 42-600	0.125	0	Based on -500 variant
Aerospatiale/Alenia ATR 72	0.25	0.25	
Airbus A300 B4/C4/F4 Freighter	2	2	Based on B4 variant
Airbus A300-600 Freighter	1	2	
Airbus A300-622R	1	2	
Airbus A320neo	0.125	0.25	
Airbus A321neo	0.25	0.25	
Airbus Industrie A319	0.25	0.5	
Airbus Industrie A320	0.25	0.5	
Airbus Industrie A320 (Sharklets)	0.25	1	
Airbus Industrie A321	0.25	1	
Airbus Industrie A321 (Sharklets	0.25	1	
Airbus Industrie A330-200	0.5	2	
Airbus Industrie A330-300	0.5	2	
Airbus Industrie A340-300	2	0.5	
Airbus Industrie A350-900	0.5	0.5	
Airbus Industries A318	0.25	0.25	
Antonov An-12	0.5	2	4 variants, 3 were 0.5 arr 2 dep.
Antonov An-26/30/32	1	2	
Avro International Aerospace Avroliner RJ100	0.5	0.5	
Avro International Aerospace Avroliner RJ85	0.5	0.25	

Historic flights QC reference table (2)

Aircraft	Est QC Arrival	Est QC Departure	Notes
BD-100 Challenger 300 CL30	0	0.125	
Beech (Light aircraft - twin piston engine)	0	0	
Beech Super King Air 200/1300 Huron	0	0	
Beech Super King Air 300	0	0	
Beechcraft 400 (Hawker 400xp)	0.125	1	
Boeing 737-300 (winglets) Passenger	1	0.5	
Boeing 737-300 Passenger	1	0.5	
Boeing 737-400 Freighter	1	0.5	
Boeing 737-400 Passenger	1	0.5	
Boeing 737-500	1	0.5	
Boeing 737-500 Passenger	1	0.5	
Boeing 737-700 (Winglets) Passenger	0.5	0.5	
Boeing 737-8 Max	0.25	0.25	
Boeing 737-800 (Winglets) Passenger	0.5	0.5	
Boeing 737-800 Passenger	0.5	0.5	
Boeing 737-900 Winglet Passenger	0.5	1	
Boeing 737-BBJ [700]	0.5	0.5	
Boeing 737-Generic	0.5	0.5	737-700
Boeing 747-400	2	4	
Boeing 747-400 Freighter	2	4	
Boeing 757-200 (winglets) Freighter	0.5	1	
Boeing 757-200 (winglets) Passenger	0.5	1	
Boeing 757-200 Freighter	0.5	1	
Boeing 757-200 Passenger	0.5	1	

Historic flights QC reference table (3)

Aircraft	Est QC Arrival	Est QC Departure	Notes
Boeing 767-200 Freighter	2	2	
Boeing 767-300 Passenger	1	2	
Boeing 767-400 Passenger	0.5	2	
Boeing 767-Freighter	1	2	767-300
Boeing 777-200 Freighter	1	2	
Boeing 777-200 LR	1	2	
Boeing 777-200 Passenger	1	2	
Boeing 777-300ER	1	2	
Boeing 777-328ER	1	2	
Boeing 787-10	0.25	1	
Boeing 787-900	0.25	1	
Boeing B767-300 Freighter Winglets	1	2	
Boeing B767-300 winglets	1	2	
Boeing B787-10	0.25	1	
Boeing B787-8	0.25	0.5	
Bombardier BD100 Challanger 300	0	0.125	
Bombardier BD-500-1A11 CS300	0.125	0.25	
Bombardier BD700 Global 5000	0	0.25	
Bombardier BD700 Global Express	0	0.25	
Bombardier Challenger 350	0	0.125	
Bombardier Global Express	0	0.25	
Bombardier Global Express 6000	0	0.25	

Historic flights QC reference table (4)

Aircraft	Est QC Arrival	Est QC Departure	Notes
British Aerospace (Hawker Siddeley) 125 700/800	0.5	1	
British Aerospace (Hawker Siddeley) 850	0.25	0.125	
British Aerospace (Hawker Siddeley) 900	0.25	0.125	
British Aerospace 146-200 Passenger	0.25	0.25	
British Aerospace 146-300 Freighter	0.5	0.5	
Canadair CL60	0.125	0.5	
Canadair CL-600 / 601 / 604 Challenger	0.125	0.125	
Canadair CL-600 Challenger	0.125	0.125	
Canadair Regional Jet - 1000	0.25	0.5	
Canadair Regional Jet -200	0.125	0.125	
Canadair Regional Jet -900	0.125	0.125	
Cessna 310	0	0	
Cessna Citation	0.125	0	CNA560 Encore Plus/560 Ultra. Encore more mvts so used
Cessna Citation 10	0.125	0	
Cessna Citation 3/6/7	0.125	0	Cessna 680
Cessna Citation 550	0.125	0.125	
Cessna Citation 560 XL	0.25	0	
Cessna Citation 560xl	0.25	0	
Cessna Citation Mustang	0	0	
Cessna Citation Sovereign	0.125	0	
Cessna Citation Sovereign 680	0.125	0	
Cessna Citationjet C525	0	0.125	
Cessna Citationjet C525 M2	0	0.125	

Historic flights QC reference table (5)

Aircraft	Est QC Arrival	Est QC Departure	Notes
Dassault Falcon 2000	0.25	0.125	
Dassault Falcon 50	0.5	0.5	
Dassault Falcon 7X	0.125	0.25	
Dassault Falcon 900LX	0.125	0.25	
Dassault-Breguet (Mystere) Falcon 10/100/20/200/2000 Generic	0.125	0.25	Actually Falcon 2000EX
Dassault-Breguet (Mystere) Falcon 20/200	0.125	0.25	Actually Falcon 2000EX
Dassault-Breguet (Mystere) Falcon 50	0.5	0.5	
Dassault-Breguet (Mystere) Falcon 50/900 Generic	0	0.25	Actually Global 5000
Dassault-Breguet (Mystere) Falcon 900	0.125	0.25	
Dassult Falcon 8X	0.125	0.25	
De Havilland Canada DHC-8 Dash 8 Series 400	0.25	0.125	
Diamond Twin Star	0	0	
Dornier 228	0	0	Exempt from UK scheme as small prop
Dornier 328	0.25	0.125	
Embraer 170	0.25	0.5	
Embraer EMB-505 Phenom 300	0	0	
Embraer Legacy 450	0	0	
Embraer Legacy 500	0	0	
Embraer Phenom 300	0	0	
Embraer RJ135	0.125	0.125	
Embraer RJ135 Legacy	0.125	0.125	
Embraer RJ145	0.125	0.125	
Embraer RJ175	0.25	0.5	
Embraer RJ190	0.125	0.5	
Embraer RJ195	0.125	0.5	

Historic flights QC reference table (6)

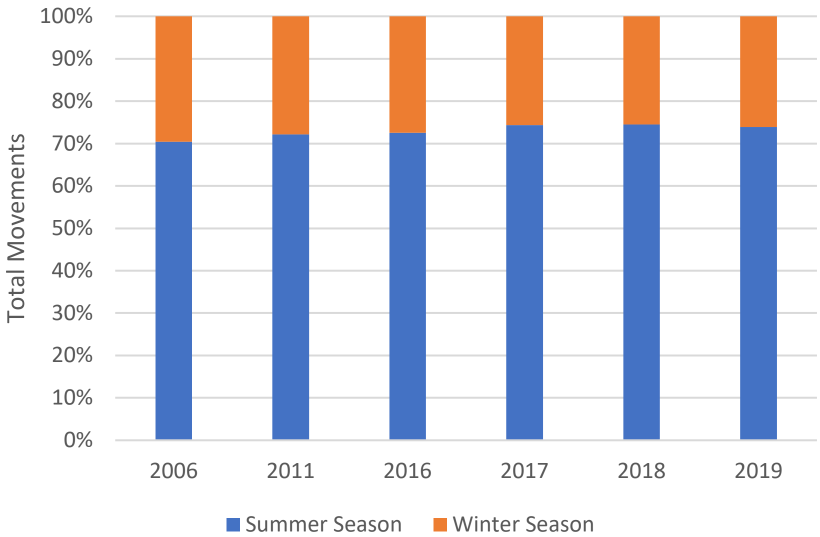
Aircraft	Est QC Arrival	Est QC Departure	Notes
Fairchild (Swearingen) Metro	0	0	Exempt from UK scheme as small prop
Fokker 100	0.25	0.5	
Gates Learjet 35	0.125	0.25	
Gates Learjet 45	0.25	0	
Gulfstream 650	0	0.125	
Gulfstream Aerospace (Grumman) Gulfstream IV	0.125	0.125	
Gulfstream Aerospace (Grumman) Gulfstream V	0.125	0.25	
Gulfstream Aerospace (Grumman) Gulfstream VI	0	0.125	
Gulfstream Aerospace 200 (Westwind Galaxy)	0.125	0.125	
Gulfstream Aerospace G200	0.125	0.125	
Gulfstream V	0.125	0.25	
Ilyushin Il-76	2	2	
Israel Aircraft Industries 1125 Astra	0.125	0.125	Used Astra SPX in CAA
McDonnell-Douglas MD-11 Freighter	2	2	
McDonnell-Douglas MD82	0.25	1	
P180 Avanti II	0	0	Exempt from UK scheme as small prop. Would not be 0 on arrival based on noise level
Pilatus PC-12	0	0	
Pilatus PC-24	0.125	0.25	
Raytheon Hawker 4000 (Horizon)	0.125	0.125	
Reims (Cessna) F406	0	0	
Saab 2000	0	0.125	
Saab SF340	0.25	0.25	

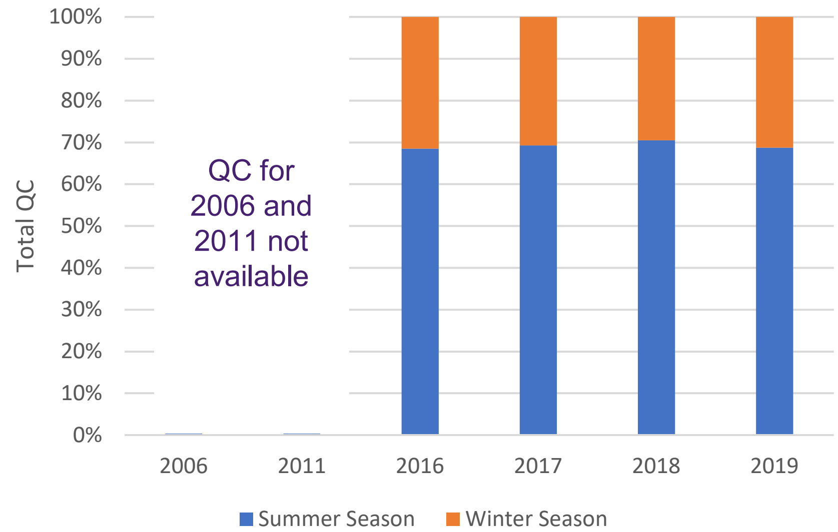
Annex C

Seasonal Movement and QC Split

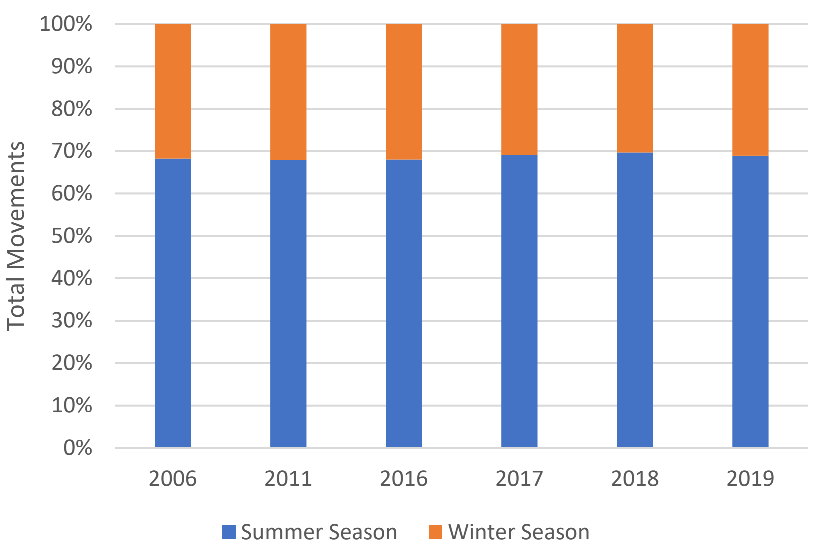
Seasonal Split Movements and QC

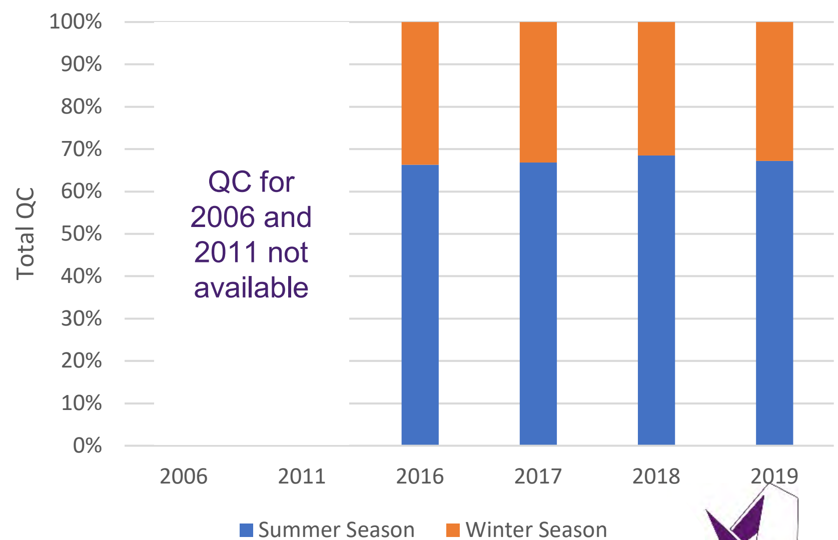
6.5hr night





8hr night





Appendix 3A. Economic Impact of Operating Restrictions

Document Classification: Class 1 - General

UPDATE REPORT – JUNE 2021

Dublin Airport Economic Impact of Operating Restrictions

PREPARED FOR

daa

PREPARED BY

Inter*VISTAS* Consulting

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InterVISTAS
a company of Royal HaskoningDHV

Executive Summary

In order to meet future demand, daa has commenced construction of the North Runway. The runway’s planning permission, granted in 2007, attaches 31 conditions, of which two are particularly problematic due to the significant negative implications they pose for the potential of the airport to operate, grow, and deliver the maximum economic and societal benefit for Fingal, Dublin and Ireland as a whole:

- Condition 3d states that the new North Runway will not be used at night between 23:00-07:00, and;
- Condition 5 limits the number of night time operations at the airport to 65 per night on average when the new runway is complete.

daa commissioned Inter*VISTAS* Consulting (Inter*VISTAS*) to conduct a study of the economic impact of restrictions on permitted operations in the period 23:00-07:00 (the “operating restrictions”) at Dublin Airport.

Due to the COVID-19 outbreak in 2020, and the associated air travel restrictions, there has been a large downturn in air traffic globally and at Dublin Airport. This May 2021 update assesses the economic impact of the operating restrictions in the context of a significantly revised traffic outlook for Dublin Airport covering the period 2022-2025.

The operating restrictions incorporated in the grant of permission for the North Runway are forecast to result in a forgone economic impact peaking at 5,170 jobs and €392 million in Gross Value Added (broadly equivalent to Gross Domestic Product) in 2023. The majority (83%) of this forgone economic impact is expected to occur outside of the aviation sector (indirect, induced and catalytic impacts) and 25% is projected to occur in Fingal.

5,170 Number of Jobs	820 Direct	480 Indirect	580 Induced	3,290 Catalytic
	At airport and airport related businesses	*Supplying and supporting businesses*	*Employees spending in the economy*	*Air service facilitating tourism, trade, investment, productivity*

392 GVA (€ Millions)	68 Direct	38 Indirect	40 Induced	246 Catalytic
	At airport and airport related businesses	*Supplying and supporting businesses*	*Employees spending in the economy*	*Air service facilitating tourism, trade, investment, productivity*

All financial figures are in 2020 prices. Numbers may not add up due to rounding.

The operating restrictions incorporated in the grant of permission for North Runway are forecast to reduce traffic at Dublin Airport by 1.8 million passengers in 2023 (-6.6%) with a cumulative loss of 6.3 million passengers between 2022 and 2025 (vs forecast passenger traffic without the operating restriction).

daa commissioned a separate study to assess and quantify the traffic impacts of the operating restrictions during the post-COVID recovery.[1] The unconstrained traffic forecast, with no operating restrictions (but with proposed noise mitigation measures)[2] and maintaining the 32 million cap on annual passengers, projects passenger traffic in 2021 to reach 7.9 million (7.0% higher than 2020) and then exhibit a stronger recovery in 2022 to 21.0 million and reach 32.0 million by 2025 (close to 2019 levels). With the impact of the operating restrictions as well as the 32 million cap (constrained scenario), passenger traffic is forecast to be 1.8 million lower by 2023 (-6.6%) and lower by 1.6 million in 2025.[3] The cumulative loss of passengers between 2022 and 2025 is 6.3 million passengers.

The operating restrictions particularly impact on the recovery and growth of Dublin based Irish carriers Aer Lingus and Ryanair, who require early morning departures and late evening arrivals for their short haul operations, and Aer Lingus requires early morning arrivals for its transatlantic operations. Non-Irish carriers are less affected by the restrictions as they have proportionately fewer operations in the restricted 23:00-07:00 period.

The forecast analysis included the development of busy day schedules for the unconstrained and constrained scenarios. The constrained schedules restricted the operations between 23:00-07:00 to 65 movements with some services being retimed out of this period or being removed entirely as they were no longer viable. The analysis found that, overall, the night operating restrictions constrained scenario resulted in 40 fewer busy day flights (5.4%) in 2025 as a result of impacted night flights that could not be realistically retimed.

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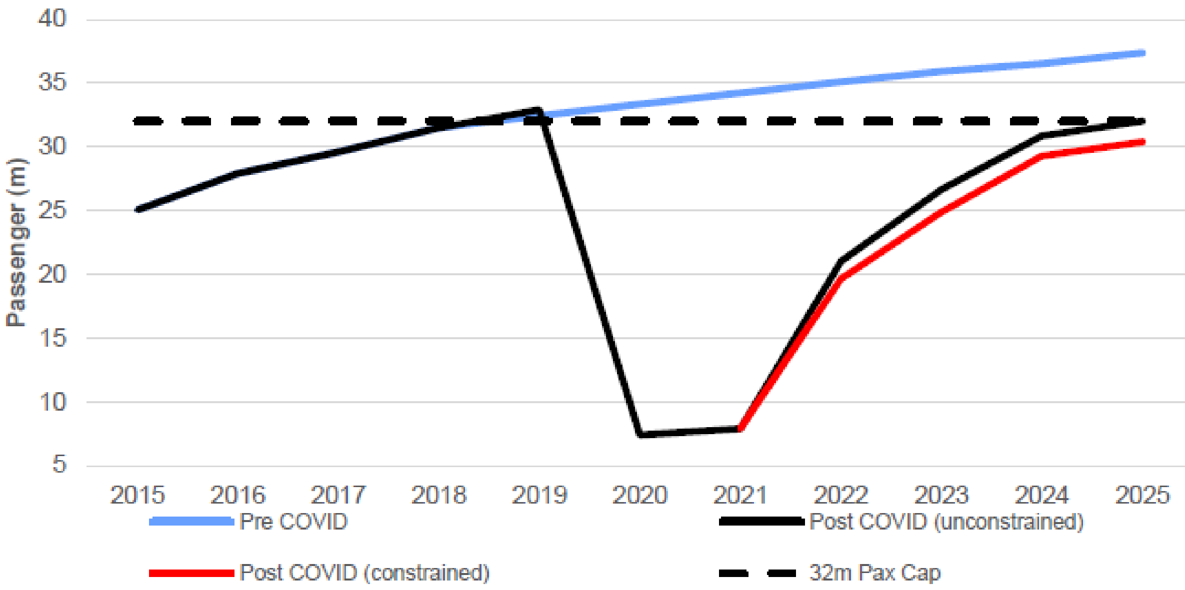
[1] "Dublin Airport Operating Restrictions - Quantification of Impacts on Future Growth – Updated analysis in response to the ANCA RFI", Version 1.2, May 2021, Mott MacDonald.

[2] The proposed mitigation measures include preferential runway usage (Southern runway preferred for the core night period of 24:00 to 06:00), a noise insulation scheme for dwellings newly affected by night noise and a noise monitoring and trigger framework at the airport.

[3] The gap between the forecasts reduces due to traffic reaching the 32 million cap in the unconstrained forecast.

Figure ES-2: Annual Traffic Impact of the Operating Restrictions



Annual Traffic Impact Summary (millions of passengers)

	2022	2023	2024	2025	2022-2025 Total
Unconstrained	21.0	26.7	30.8	32.0	110.5
Constrained	19.6	24.9	29.3	30.4	104.2
Difference	-1.4	-1.8	-1.6	-1.6	-6.3

Source: Mott Macdonald analysis. Unconstrained is the Scenario D from the forecast analysis - without Conditions 3d and 5 in place and with 32m annual passenger cap (Proposed scenario); constrained is Scenario E - with Condition 3d and 5 in place and the 32m annual passenger cap. (Permitted scenario) referred to in the planning application and Environmental Impact Assessment Report (EIAR).

The operating restrictions will have a range of implications for the wider economy and run counter to National Aviation Policy.

The implications of the operating restrictions would extend across the entire economy, due to the lower connectivity that Dublin Airport would be able to offer:

The restrictions will impact on the post-COVID recovery. Like most parts of the world, the COVID-19 outbreak has had a severe impact on the Irish economy with *Modified Domestic Demand* (which strips out the impact of multinational companies) declining by 5.4% in 2020. The Distribution, Transport, Hotels & Restaurants sector contracted by 16.7% and there was also a 70% decline in nights spent in tourist accommodation. The economic recovery will depend on the Irish economy fully re-opening for business, and aviation will play an important role in this regard. Aviation is a major employer in its own right and also facilitates many other sectors of the economy. Any restrictions on air connectivity at Dublin Airport during this recovery period will have a knock-on effect on these other sectors of the economy: business travel will be more restricted and costly, tourism will be hampered, and the hub benefits of Dublin Airport will be diminished.

Restricted early morning departures to Europe will hamper business connectivity. The operating restrictions will significantly hamper the ability of Dublin-originating passengers to arrive at European destinations in the morning and conduct same-day trips to Europe. With reduced availability of early morning flights, some business travellers would need to depart the day before, incurring significant additional accommodation/subsistence costs for businesses, as well as loss of employee productivity. More travellers may be forced to cancel their trip entirely. This will put Irish businesses at a competitive disadvantage to businesses located in regions with greater access to air services. It will also make the Republic of Ireland a less attractive location to base international businesses, especially those seeking a base for their European operations.

Reduced long haul connectivity will impact business and tourism. Since long haul services are often dependent on connecting traffic, the loss of connecting options associated with the operating restrictions could impact on the viability of long haul services. Any reduction in long-haul services will make Ireland a more difficult destination to visit for some tourists and will reduce its attractiveness for businesses considering locating or investing in Ireland.

The operating restrictions will hamper Dublin's ability to develop as hub airport. Hub airports create economies of scale by pooling both point-to-point traffic (traffic originating or terminating at Dublin) with transferring traffic (passengers connecting between aircraft at Dublin enroute to their final destination). The benefit of attracting transfer traffic is that air services can be supported that could not be sustained on the basis of point-to-point traffic. However, restrictions on night and early morning operations, as described above, will hamper Dublin's ability to act as a hub, by reducing opportunities for convenient transfers. Competition for transfer traffic is strong – transfer traffic can move to any convenient airport in Europe (or elsewhere). The operational restrictions will place Dublin at a considerable competitive disadvantage.

The range of destinations connected to Ireland will be reduced. The operating restrictions will reduce the number of destinations directly connected to Dublin, impacting tourism, trade and business development.

Air fares could increase. The restricted operations will limit the number of hours some aircraft can be operated, potentially reducing aircraft utilisation and, as a result, lead to higher unit costs. These higher costs may be passed onto passengers or result in lower route profitability, with implications for service viability. Furthermore, the limited availability of early morning slots could limit airline competition at these times, resulting in higher fares.

Airlines may base aircraft outside of Ireland. Airlines based at Dublin, currently Aer Lingus and Ryanair, may seek to base some aircraft at airports without operating restrictions in order to improve aircraft utilisation. Ryanair in particular has a wide range of bases located across Europe. This will reduce the economic activity associated with the aviation sector in Ireland (e.g., aircraft maintenance, air crew employment, etc.).

Air cargo will be impacted. Many air cargo operations occur during the night and these operations are very time-critical in order to connect at sorting hubs and to achieve an overnight package delivery service. A recent study found that 38% of Dublin's air freight was flow at night.[4] The reduction in air cargo services due to the operating restrictions will impact Ireland's trade and supply chain competitiveness.

The operating restrictions run counter to National Aviation Policy. The National Aviation Policy, published by the Department of Transport, Tourism and Sport in 2015, has the following key goals: enhance Ireland's connectivity, foster growth of aviation enterprise, and maximise the economic contribution of the aviation sector.[5]

The operating restrictions imposed by the planning permission for North Runway contradict the aims and commitments of the National Aviation Policy. The negative effects of the operating restrictions on both long haul and short haul flights reduce the connectivity and competitiveness of Dublin Airport. Consequently, the decreased traffic and air services result in a reduced economic contribution to the national economy, as documented below.

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[4] "The Economic Impact of Cargo Night Flying at Dublin Airport", Freight Transport Association Ireland, March 2020.

[5] Department of Transport, Tourism and Sport, A National Aviation Policy for Ireland, August 2015.

Economic impact of the operating restrictions: the forgone economic impact resulting from the operating restrictions is projected to peak at 5,170 jobs and €392 million in GVA in 2023.

The estimates of forgone economic impact in 2022, 2023, 2024 and 2025 are presented in **Figure ES-3**. The analysis suggests that as a result of the operating restrictions, the Irish economy could forgo an additional 5,170 jobs and €392 million in GDP by 2023, relative to unrestricted night operations with the proposed noise mitigation measures. The forgone economic is projected to reduce after 2023 as the 32 million cap on passengers starts to reduce the gap between the forecast scenarios. By 2025, the forgone economic impact is estimated to be 4,120 jobs and €314 million in GDP. The majority of this forgone economic impact is expected to occur outside of the aviation sector – 62% of the total impact is catalytic impacts (tourism, trade, investment, etc.) and another 21% are indirect and induced impacts (supplier and spending in the wider economy). This forgone economic impact is approximately 3% of the total projected economic impact of Dublin Airport in 2025 – in other words, the economic contribution of Dublin Airport will be reduced by 3% due to the operating restrictions. To put this into context, the number of jobs forgone at its peak in 2023 is higher than the total employment of either Google or Facebook in Ireland.[6]

Based on the current distribution of jobs and economic impact, it is anticipated that a significant proportion of this forgone economic impact will be felt in the Fingal region, with 89% of the forgone direct employment and at least 25% of the forgone total employment (direct, indirect, induced and catalytic impacts) located in Fingal.

[6] Source: The Irish Time Top 1000: Google – 3,300; Facebook – 4,500.

Figure ES-3: Forgone Economic Impact Resulting from Operating Restrictions

Impact	Number of Jobs	Full-Time Equivalents (FTEs)	Wages (€ Millions)	GVA (€ Millions)
2022 Impact				
Direct	630	560	26	52
Indirect	360	320	15	29
Induced	440	390	15	31
Catalytic	3,130	2,760	119	234
Total	**4,560**	**4,030**	**175**	**345**
2023 Impact				
Direct	820	730	34	68
Indirect	480	420	20	38
Induced	580	510	20	40
Catalytic	3,290	2,910	126	246
Total	**5,170**	**4,570**	**199**	**392**
2024 Impact				
Direct	740	660	30	61
Indirect	430	380	18	34
Induced	520	460	18	36
Catalytic	2,850	2,520	109	213
Total	**4,540**	**4,020**	**175**	**345**
2025 Impact				
Direct	760	680	31	63
Indirect	440	390	18	35
Induced	530	470	19	37
Catalytic	2,390	2,110	91	179
Total	**4,120**	**3,650**	**159**	**314**

All financial figures are in 2020 prices.
Numbers may not add up due to rounding.

Glossary of Terms and Abbreviations

Catalytic Impacts	*Catalytic Impacts*, also known as Wider Economic Benefits, captures the way in which specific economic activities facilitates further economic or business impacts in other sectors of the economy. Air transport creates catalytic impacts primarily through increased connectivity and improves national economic performance through the following mechanisms: tourism, trade in goods and services, investment, and increased productivity.
COVID-19	COVID-19 is a disease caused by a new strain of coronavirus which first identified in December 2019 and which spread globally as a pandemic during 2020. In an attempt to control the spread of the outbreak, many governments enacted measures to restrict air travel or quarantine international travellers, which resulted in a massive decline in air travel globally and in Ireland.
CSO	Central Statistics Office, Ireland.
daa	State owned commercial corporation responsible for the operation and management of Dublin and Cork airports.
Direct impacts	*Direct Impacts* arise immediately from the conduct of those entities performing the activity in question. For an airport, the “direct impacts” would include the activities of airlines, the airport itself, forwarders, ground handling agents, and other firms whose principal business involves commercial aviation.
E/D Passengers	Enplaned/deplaned passengers. A measure of passenger volume that counts each passenger who enplanes or deplanes an aircraft.
Economic Impact	Economic impact is a measure of the employment, spending and economic activity associated with a business, a sector of the economy, a specific project (such as the construction of a new facility), or a change in government policy or regulation.
FDI	Foreign Direct Investment. Investment from one country into another (normally by companies rather than governments) that involves establishing operations or acquiring tangible assets, including stakes in other businesses.
FTE	A full-time equivalent (FTE) year of employment is equivalent to the number of hours that an individual would work on a full-time basis for one year (also known as a person year). FTEs are useful because part-time and seasonal workers do not account for one full-time job.
GDP	Gross Domestic Product, a measure of the total output of an economy.

GVA	Gross Value Added (GVA) – the value of the operating surpluses of business linked to Dublin Airport, plus the income/wages of employees and consumption of fixed capital. GVA is broadly equivalent to Gross Domestic Product (GDP), whereby the value-added of each industry sums to the total GDP of an economy.
I-O Model	Input-Output (I-O) model. A representation of the flows of economic activity within a region or country. An I-O model captures what each business or sector must purchase from every other sector in order to produce a dollar's worth of goods or services.
Indirect impacts	*Indirect Impacts* involve the supply chain of the businesses or entities conducting the primary activity (i.e., those included in the direct impact). The airlines at an airport purchase fuel which has been refined at a plant and transported to the airport by pipe or truck. Catering companies at the airport buy food from wholesalers. The items purchased can be used for many purposes besides commercial aviation, and would usually occur off site. The materials support the primary aviation activity, although they could be used for many purposes.
Induced impacts	*Induced impacts* capture the economic activity generated by the employees of firms directly or indirectly connected to the airport spending their income in the national economy. For example, an airline employee might spend his/her income on groceries, restaurants, child care, dental services, home renovations and other items which, in turn, generate employment in a wide range of sectors of the general economy.
Low Cost Carrier (LCC)	Also known as low fares, no-frills or budget carriers. These are airlines that generally have lower fares and fewer amenities than network or legacy carriers. Although there is considerable variation in the business models, low cost carriers typically operate a single aircraft type (to reduce training and maintenance costs), do not offer first or business class travel, do not provide in-flight services such as meals and entertainment (or offer them at additional charge), and focus on point-to-point travel offering limited connecting options. Examples in Europe include EasyJet, Ryanair, Wizz Air, Norwegian Air Shuttle and Vueling.
Multiplier Impacts	Economic multipliers are used to infer indirect and induced effects from a particular sector of the economy. These are typically derived from an Input-Output model.
Wider Economic Benefits	See *Catalytic Impacts*.

Contents

1 Introduction

In order to meet future demand, daa has commenced construction of the North Runway.[7] The runway's planning permission, granted in 2007, attaches 31 conditions, of which two are particularly problematic due to the significant negative implications they pose for the potential of the airport to operate, grow and deliver the maximum economic and societal benefit for Fingal, Dublin and Ireland as a whole:

- Condition 3d states that the new North Runway will not be used at night between 23:00-07:00, and;
- Condition 5 limits the number of night time operations to 65 per night on average when the new runway is complete.

daa commissioned Inter*VISTAS* Consulting (Inter*VISTAS*) to conduct a study of the economic impact of restrictions on permitted operations in the period 23:00-07:00 (the "operating restrictions") at Dublin Airport.

The original work was finalised in August 2019. Due to the COVID-19 outbreak in 2020, and the associated air travel restrictions, there has been a large downturn in air traffic globally and at Dublin Airport. An update to the economic impact analysis was conducted in October 2020 assesses the economic impact of the operating restrictions in the context of a significantly revised traffic outlook for Dublin Airport covering the period 2022-2025.[8] This has been further updated in this report to reflect the traffic outlook as of May 2021.

This report documents the methodology and findings of the study, and is structured as follows:

- Chapter 1 – introduction.
- Chapter 2 outlines the methodology used to estimate the economic impact of the operating restrictions attached to the grant of planning.
- Chapter 3 summarises the traffic and demand implications of the operating restrictions at Dublin Airport taken from separate research commissioned by daa which reflects the impact of the COVID-19 outbreak.
- Chapter 4 provides the forgone economic impact resulting from the proposed operating restrictions at Dublin Airport – the lost employment and GDP in Ireland that will result.

Additional details are provided in the appendices. *Key Points* text boxes are provided at the start of the chapters which summarise the key points in each chapter.

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[7] daa is a state owned corporation responsible for the operation and management of Dublin and Cork airports.

[8] The impact of the operating restrictions was compared with a scenario where there are no operating restrictions and instead noise mitigation measures are put in place. The proposed noise mitigation measures include preferential runway usage (Southern runway preferred for the core night period of 24:00 to 06:00), a noise insulation scheme for dwellings newly affected by night noise and a noise monitoring and trigger framework at the airport.

1.1 What is Economic Impact?

Economic impact is a measure of the employment, spending and economic activity associated with a business, a sector of the economy, a specific project (such as the construction of a new facility), or a change in government policy or regulation. In this case, economic impact refers to the economic contribution associated with the ongoing activities at Dublin Airport. Economic impact can be measured in a number of ways:

- **Employment** – the number of people employed by businesses involved in activities linked to Dublin Airport.
- **Income/Wages** – the wages and salaries earned by the people employed in activities linked to Dublin Airport.
- **Gross Value Added (GVA)** – the income/wages of employees above *plus* the operating surpluses of business linked to Dublin Airport and the consumption of fixed capital. GVA is broadly equivalent to *Gross Domestic Product* (GDP), whereby the value-added of each industry sums to the total GDP of an economy.[9]

1.2 Categories of Economic Impact

There are four distinct types or categories of economic impact associated with airports, as described below.

1.2.1 Direct Economic Impact

This is the employment, income and GDP associated with the operation and management of activities at Dublin Airport including firms on-site at the airport and airport-related businesses located elsewhere near the airport. This includes activities by the airport operator, the airlines, air traffic control, fixed base operators (General Aviation), ground handlers, airport security, immigration and customs, aircraft maintenance, etc.

While a straight-forward definition of the direct airport economic impact would be the activities and businesses located at the airport, this would not reflect the full extent of the airport's economic base. Other businesses closely connected to airport activities are not based at the airport (or only partially based at the airport), such as aircraft maintenance, logistics operators, aircraft parts suppliers, etc. These businesses would not exist, or would be much smaller, without the activities at the airport. Therefore, off-airport businesses closely linked to airport activities were also included as part of the direct economic impact.

1.2.2 Indirect Economic Impact

The employment, income and GDP generated by upstream industries that supply and support the activities at Dublin Airport. For example, these include: wholesalers providing food for inflight catering, companies providing accounting and legal services to airlines, travel agents booking flights, etc.

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[9] GDP is the sum of the GVA of all industries plus taxes less subsidies on production.

1.2.3 Induced Economic Impact

This captures the economic activity generated by the employees of firms directly or indirectly connected to the airport spending their income in the national economy. For example, an airline employee might spend his/her income on groceries, restaurants, child care, dental services, home renovations and other items which, in turn, generate employment in a wide range of sectors of the general economy.

1.2.4 Catalytic Economic Impacts

While the aforementioned economic impact can be seen as resulting from activities at Dublin Airport, catalytic impacts (also known as Wider Economic Benefits) capture the way in which the airport facilitates the business of other sectors of the economy. As such, air transportation facilitates employment and economic development in the national economy through a number of mechanisms:

- **Tourism**. Air service facilitates the arrival of larger numbers of tourists to a region or country. This includes business as well as leisure tourists. The spending of these tourists can support a wide range of tourism-related businesses: hotels, restaurants, theatres, car rentals, etc. Of course, air service also facilitates outbound tourism, which can be viewed as reducing the amount of money spent in an economy. However, even outbound tourism involves spending in the home economy, on travel agents, taxis, etc. In any case, it is not necessarily the case that money spent by tourists flying abroad would be spent on tourism at home if there were no air service.
- **Trade in Goods and Services**. Whereas air cargo accounts for 1% of Ireland's exports by volume, it accounts for over 35% of exports by value, reflecting generally higher value goods often times perishable or time-critical.[10] Both the trade of goods and the trade of services are facilitated by passenger air services. Face-to-face meetings play a crucial role in making sales and delivering services and support. The ability to be at a client's side rapidly and cost-effectively is important to many industries. Much of the time, these functions cannot be replaced by teleconferencing or other forms of communication. A study in the UK found that a 10% increase in seat capacity increased goods exports by 3.3% and goods imports by 1.7%.[11]

  Air transport connects businesses to a wide range of global markets, providing a significantly larger customer base for their products than would be accessible otherwise. It is particularly important for high-tech and knowledge-based sectors, and suppliers of time-sensitive goods.
- **Investment**. Air connectivity is important in attracting international business headquarters and foreign investment into a country. A key factor many companies take into account when making decisions about the location of offices, manufacturing plants

[10] Source: Irish Exporters Association.

[11] PWC (2013), "Econometric Analysis to Develop Evidence on the Links Between Aviation and the Economy", Report for the UK Airports Commission, December 2013.

or warehouses is proximity of an international airport. A study by IATA of 625 businesses in five countries (including China and the United States) found that 25% of the sales of the surveyed businesses were dependent on good air transport links. Further, 30% of Chinese firms reported that they had changed investment decisions because of constraints on air services. [12] Another study found that a 10% increase in supply of intercontinental air service was associated with a 4% increase in the number of large firm headquarters located in the corresponding urban area.[13] Ireland's island status makes air connectivity even more critical.

Therefore, airports are essential assets for regions wishing to expand industrial activity. Their proximity encourages industrial development. Industries choose to locate close to airports in order to gain easy access to air transport and the associated infrastructure.

- **Productivity**. Air transportation offers access to new markets, which in turn enables businesses to achieve greater economies of scale; inward investment can enhance the productivity of the labour force (e.g., state-of-the-art manufacturing facilities); air access also enables companies to attract and retain high quality employees. All of these factors contribute to enhanced productivity, which in turn increases national income. A study for Airports Council International (ACI) Europe found that a 10% increase in connectivity was associated with an increase in GDP per capita of 0.6%.[14]

Additional research evidence on the link between aviation and economic development is summarised in **Appendix B**.

In effect, the catalytic impact of aviation is to increase the productive potential of the economy (in economist terms, moving the production–possibility frontier). Improvements in aviation connectivity enable economies to attract more tourists, conduct more trade and draw more foreign investment. The overall effect of all these mechanisms is an increase in employment and GDP. Without effective air transportation links, it is much harder for economies to attract tourists, to conduct trade and attract investment from other countries. As a result, the country's economy and employment potential would suffer.

It should be noted that catalytic impacts are not a simple matter of the airport generating employment and economic activity in the same way that direct, indirect and induced impacts arise. National economies are far more complex than that. It clearly takes a wide range of players acting together to generate economic growth – government, business, infrastructure providers, residents, etc. For example, providing air connectivity alone does not guarantee large volumes of tourists. Hotels, restaurants, retail and entertainment etc. are also required. Nevertheless, without convenient air services, a destination will find it more difficult to attract tourists.

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[12] *Airline Network Benefits*, IATA Economic Briefing No. 3, 2006.

[13] Bel, G. and Fageda, X. (2008), "Getting There Fast: Globalization, Intercontinental Flights and Location of Headquarters", Journal of Economic Geography, Vol. 8, No. 4.

[14] Inter*VISTAS* Consulting, "The Economic Impact of European Airports: A Critical Catalyst to Growth", ACI Europe, January 2015.

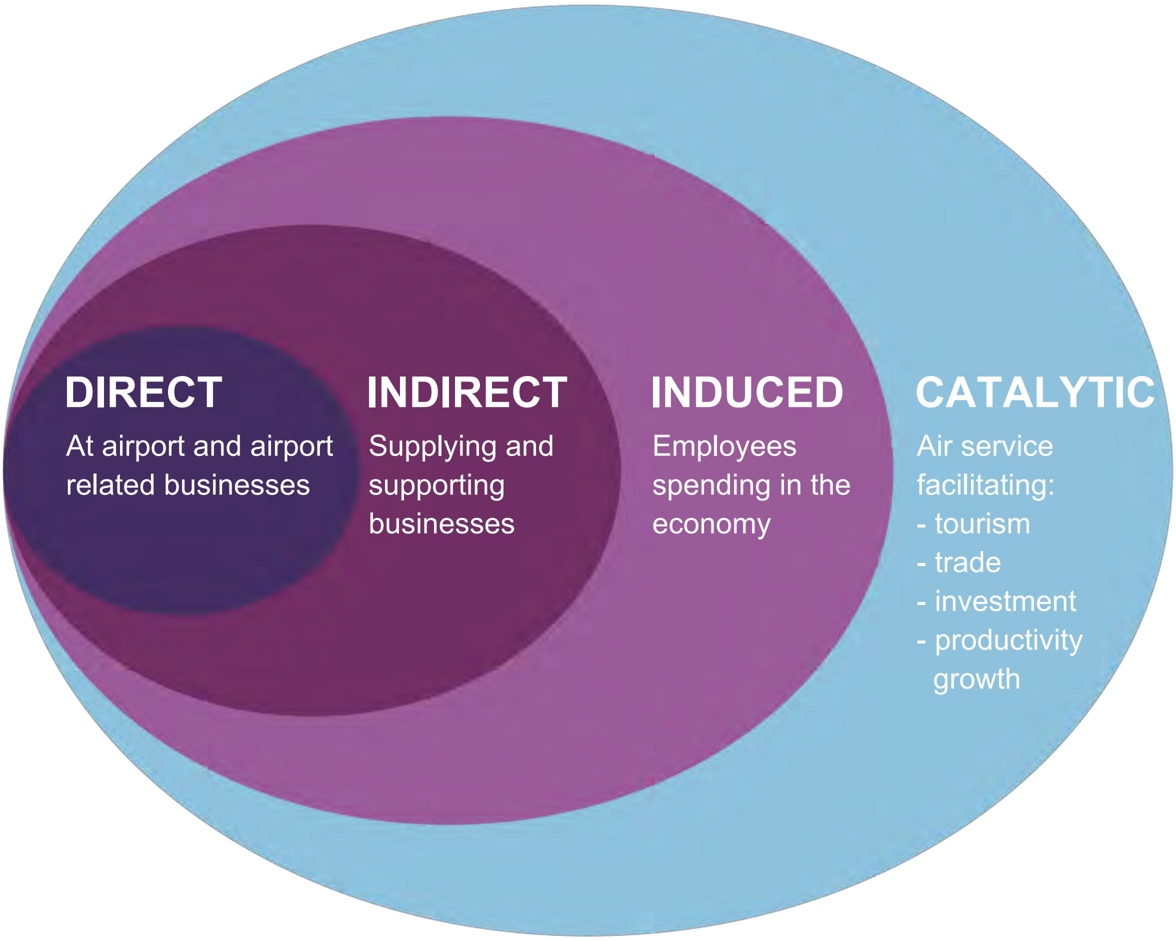
What the catalytic impacts capture is that without efficient airports and associated air services, the economy would be smaller and less affluent. Thus, catalytic impacts are about the economic value and employment that airports facilitate rather than generate. The connectivity enabled by airports is not sufficient on its own to fully support economic activity, but it is a necessary element of economic growth and development.[15]

In discussing catalytic impacts, the issue of causality often arises. For example, while air service can facilitate trade, it is also true that increased trade leads to increased demand for air services. This study recognises that there is a two-way relationship between air connectivity and economic growth. Economic growth stimulates demand for air services while at the same time, these air services open up new opportunities for tourism, trade, business development, etc. This in turn can stimulate further demand for air services, and so on, in a "virtuous cycle". The analysis in this study uses parameters that control for this two-way relationship.

These four categories of impacts are summarised in **Figure 1-1**.

[15] In many parts of the world, airports are also the contributors of some of the other necessary elements for catalytic growth. Various airports have developed their own economic and urban hubs, which can comprise of hotels, offices, entertainment, and other commercial developments, which benefit from the adjacent air connectivity provided by the airport.

Figure 1-1: Categories of Economic Impact Generated or Facilitated by Dublin Airport



2 Methodology for the Economic Impact Study

This chapter describes the methodology and sources that were used to measure the economic impact of operating restrictions at Dublin Airport. The results are provided in **Chapter 4**.

2.1 Previous Economic Impact Study

In 2019, daa commissioned Inter*VISTAS* to conduct an updated economic impact study of Dublin Airport. The study, released August 2019, estimated the direct, indirect, induced and catalytic impacts of the airport measured in terms of employment (jobs and FTEs), incomes and GVA.

The estimated economic impact of Dublin Airport is documented in the report, "*Economic Impact of Dublin Airport*", InterVISTAS Consulting, August 2019, and is available at: https://www.dublinairport.com.

2.2 Estimating the Impact of the Operating Restrictions

The 2019 economic impact evaluation formed the basis for the analysis of the operating restrictions. The estimates of the future economic impact of Dublin Airport were assumed to grow from this baseline as a function of air traffic forecasts for the airport. Air traffic forecasts for Dublin Airport, produced May 2021, were provided by daa for the period 2022-2025.[16] These included a forecast assuming no operating restrictions but maintaining the 32 million cap on annual passenger volumes ("unconstrained") and another assuming the application of the operating restrictions specified in the current planning permission as well as the 32 million cap ("constrained"), both reflecting the post-COVID outlook.[17]

While increased air traffic is expected to result in increased employment, the growth in employment is not always in proportion to the growth in traffic. Employment elasticities were applied reflecting the anticipated relationship between forecast traffic growth and employment growth. To account for productivity gains and economies of scale, the direct employment impacts were estimated assuming an economic impact elasticity of 0.67, i.e., each 1% increase in traffic results in a 0.67% increase in airport activity. This elasticity was based on previous research on European airports for ACI Europe, which found evidence of

[16] "Dublin Airport Operating Restrictions - Quantification of Impacts on Future Growth – Updated analysis in response to the ANCA RFI", Version 1.2, May 2021, Mott MacDonald.

[17] Unconstrained is the Scenario D from the forecast analysis - without Conditions 3d and 5 in place and with 32m annual passenger cap (Proposed scenario); constrained is Scenario E - with Condition 3d and 5 in place and the 32m annual passenger cap. (Permitted scenario) referred to in the planning application and Environmental Impact Assessment Report (EIAR).

economies of scale in airport employment.[18] The multiplier impacts (indirect and induced) were estimated from the direct impacts, using the multiplier ratios from the 2019 study, calculated from the CSO's latest I-O tables.[19]

Similarly, the estimates of catalytic impacts were based on forecasts of future connectivity derived from air traffic forecasts for Dublin Airport. The catalytic impacts of Dublin Airport were calculated using generalised parameters drawn from statistical analysis of historical data. As with the 2019 analysis, the catalytic parameter was taken from a study undertaken by Inter*VISTAS* on behalf of ACI Europe,[20] which was selected because it is the mostly recently completed study of this sort and is based on data from 40 European countries including Ireland. The parameter captures the aggregate net effect of a range of catalytic impacts, including tourism, trade, investment, business location, etc., which manifest themselves as greater per capita GDP.

The COVID-19 related traffic declines in 2020 (and the reduced traffic volumes in subsequent years) are anticipated to result in a lower economic impact from Dublin Airport than would otherwise be the case. Layoffs and redundancies in the aviation sector lower the direct impact of the airport while the indirect impacts are affected by reduced business-to-business spending by companies at the airport. Similarly, the loss of connectivity at the airport reduces the potential catalytic impacts. The projected declines in economic impact were benchmarked against available information from the major airlines and other businesses located at Dublin Airport on current or planned headcount reductions. With traffic forecast to recover after 2021, the future direct employment impacts were estimated assuming an economic impact elasticity, as described previously.

The methodology above was applied to the forecasts without the operating restrictions (unconstrained) and the forecasts with the restrictions (constrained). The forgone economic impact was then calculated by subtracting the economic impact under the constrained forecast from the economic impact under the unconstrained forecast.

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[18] "The Economic Impact of European Airports: A Critical Catalyst to Growth", ACI Europe, January 2015. Similar approaches have also been used in the regulatory analysis of airports.

[19] The multiplier analysis has been updated using I-O tables available from the CSO, published in October 2018 and available here: https://www.cso.ie/en/releasesandpublications/ep/p-sauio/supplyanduseandinput-outputtablesforireland2015/.

[20] "The Economic Impact of European Airports: A Critical Catalyst to Growth", ACI Europe, January 2015.

3 Traffic Impacts of Operating Restrictions

Key Points

- The post-COVID forecasts project a limited recovery in 2021 followed by a stronger recovery from 2022 onwards, with traffic reaching 32 million (close to 2019 levels) by 2025 in the scenario without operating restrictions.
- The operating restrictions attached to the grant of permission for North Runway are forecast to constrain traffic at Dublin Airport by 1.8 million passengers (-6.6%) in 2023, and result in a cumulative loss of 6.3 million passengers between 2022 and 2025.
- The operating restrictions particularly impact on the recovery and growth of Dublin based Irish carriers Aer Lingus and Ryanair.

daa commissioned a separate analysis to assess and quantify the traffic impacts of the proposed operating restrictions during the post-COVID recovery.[21] This chapter provides a summary of that analysis.

3.1 Demand Impacts of the Operating Restrictions

Dublin Airport has been the busiest airport in the Republic of Ireland. In 2019, the airport handled 32.9 million passenger movements and offered scheduled and charter service to over 180 destinations in 40 countries on four continents. The airport has two main carriers: Ryanair and Aer Lingus. Ryanair has a 35% market share and Aer Lingus a 29% share (based on Summer 2019 schedule). The airport serves mostly short haul services (87% of flights) to points in the UK and Europe. The long haul destinations are largely located in North America, with some located in Asia, Middle East and Africa.

In order for airlines to maximise their aircraft utilization on short haul flights, and in turn ensure route viability and profitability, the first departures of the day take place between 06:00-07:00, and the final arrivals take place after 23:00. Furthermore, the one-to-two hour time difference between Ireland and Continental Europe means that flights need to leave early (before 7AM) to ensure a full working day at the destination. The geographical position of Dublin means that there are longer sector distances to European destinations than other competing airports. This requires Dublin Airport to have longer operating days than many other European hubs. Long haul arrivals and a number of cargo flights also take place in the early morning to account for the time differences with long haul international destinations.

The duration of the proposed operating restrictions period, spanning 8 hours from 23:00 to 07:00, is unusually broad compared to other airports with such restrictions. As documented

[21] "Dublin Airport Operating Restrictions - Quantification of Impacts on Future Growth – Updated analysis in response to the ANCA RFI", Version 1.2, May 2021, Mott MacDonald.

in a separate report, the average night restrictions periods are 6h to 6.5h in duration.[22] For example, the London airports night restrictions period is 23:30 to 06:00 local time. The Dublin Airport operating restrictions period is also unusual in that it includes a peak hour of demand at the airport: 06:00-07:00. Therefore, the impact of the restriction on future growth is significant.

The pre-COVID level of demand for operations at Dublin Airport averaged circa 100 per night, with 113 flights associated with regularly scheduled service on a typical busy day in Summer 2019. This is far in excess of the proposed limit of 65 per night. Demand for night flights is forecast to grow in line with the number of based-aircraft at Dublin Airport operating short haul services and with long haul growth to North America in particular.

3.2 Constrained Traffic Impacts

Figure 3-1 shows the post-COVID recovery forecasts alongside the pre-COVID Centreline forecasts for Dublin Airport out to 2025. The unconstrained forecast, with no operating restrictions but with proposed noise mitigation measures,[23] projects passenger traffic in 2021 to reach 7.9 million (7.0% higher than 2020) and then exhibit a stronger recovery in 2022 to 21.0 million and reach 32.0 million by 2025. The constrained forecast shows a loss of 1.8 million passengers by 2023 (-6.6%) relative to the unconstrained forecast, declining to a loss of 1.6 million in 2025 as the gap between the forecasts reduces due to traffic reaching the 32 million cap in the unconstrained forecast. The cumulative loss of passengers between 2022 and 2025 is 6.3 million passengers.

The operating restrictions particularly impact on the recovery and growth of Dublin based Irish carriers Aer Lingus and Ryanair, who require early morning departures and late evening arrivals for their short haul operations, and Aer Lingus requires early morning arrivals for its transatlantic operations. Non-Irish carriers are less affected by the restrictions as they have proportionately fewer operations in the restricted 23:00 to 07:00 period.

The operating restrictions constrain growth in short haul operations throughout the day, as the lack of night slots limits the number of Dublin based aircraft that can be accommodated, with each aircraft performing multiple flights during the operating day.

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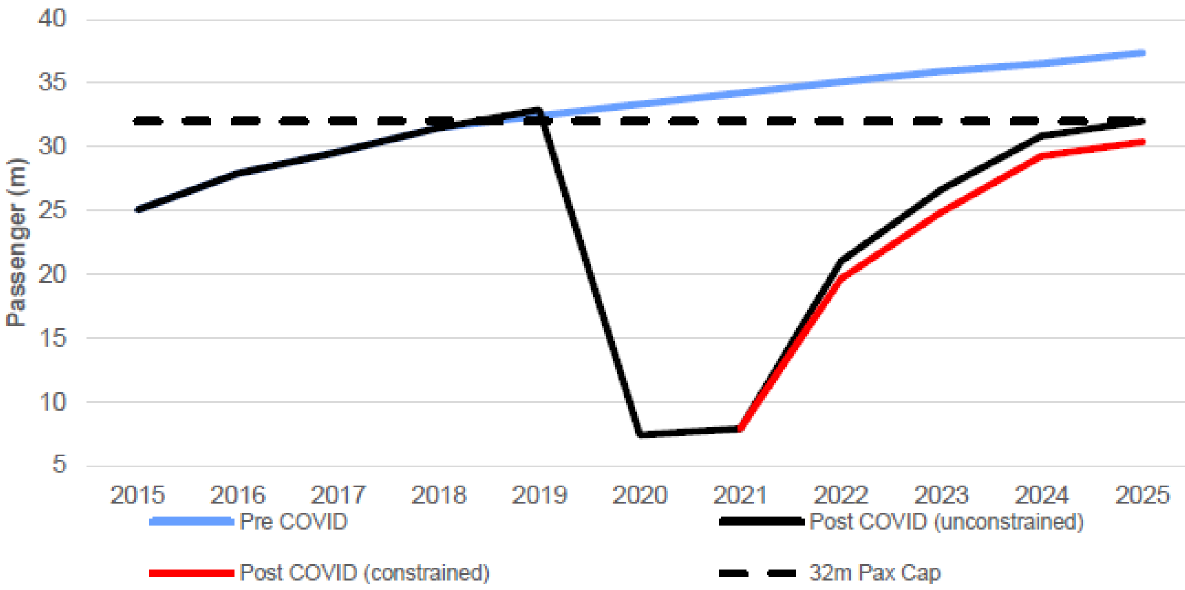
[22] "Dublin Airport Operating Restrictions - Quantification of Impacts on Future Growth – Updated analysis in response to the ANCA RFI", Version 1.2, May 2021, Mott MacDonald.

[23] The proposed mitigation measures include preferential runway usage (Southern runway preferred for the core night period of 24:00 to 06:00), a noise insulation scheme for dwellings newly affected by night noise and a noise monitoring and trigger framework at the airport.

Figure 3-1: Annual Traffic Impact of the Operating Restrictions



Annual Traffic Impact Summary (millions of passengers)

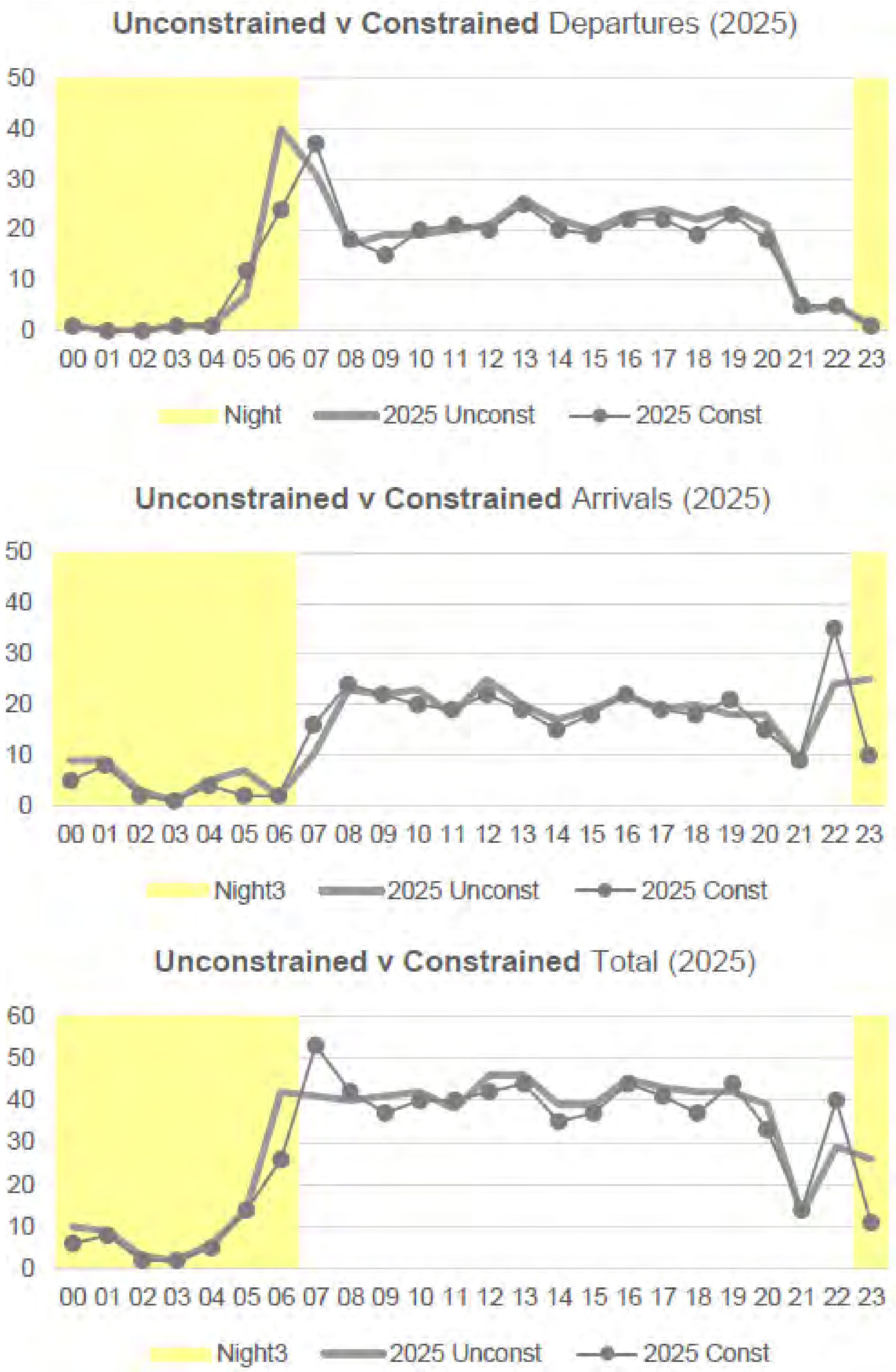
	2022	2023	2024	2025	2022-2025 Total
Unconstrained	21.0	26.7	30.8	32.0	110.5
Constrained	19.6	24.9	29.3	30.4	104.2
Difference	-1.4	-1.8	-1.6	-1.6	-6.3

Source: Mott Macdonald analysis. Unconstrained is the Scenario D from the forecast analysis - without Conditions 3d and 5 in place and with 32m annual passenger cap (Proposed scenario); constrained is Scenario E - with Condition 3d and 5 in place and the 32m annual passenger cap. (Permitted scenario) referred to in the planning application and Environmental Impact Assessment Report (EIAR).

The forecast analysis included the development of busy day schedules for the unconstrained and constrained scenarios for each year from 2022 to 2025. The constrained schedules restricted the operations between 23:00-07:00 to 65 movements with some services being retimed out of this period or being removed entirely as they were no longer viable. The analysis found that, overall, the night operating restrictions constrained scenario resulted in 40 fewer busy day flights (5.4%) in 2025 as a result of impacted night flights that could not be realistically retimed.

Figure 3-2 summarises the effect of the operating restriction based on the 2025 schedule (similar patterns arise in the schedules for 2022-2024). The morning departures peak is shifted from the 06:00 hour to the 07:00 hour, and the total peak more pronounced, while the evening arrivals peak is shifted from the 23:00 hour to the 22:00 hour due to the constraints of the operating restriction.

Figure 3-2: Unconstrained and Constrained Peak Day Profile



Source: Mott Macdonald analysis.

4 Forgone Economic Impact Resulting from Operating Restrictions

Key Points

- The operating restrictions will have implications for the wider economy of Ireland, impacting trade, tourism, investment and economic growth.
- These restrictions run counter to the stated objectives of the National Aviation Policy, in particular the development of new routes and services, the fostering of competition and to enhance Ireland's global connectivity.
- Furthermore, the operating restrictions could impact on Ireland's post-COVID economic recovery by impeding the rebuilding of air connectivity.
- It is estimated that with the operating restrictions, the forgone economic impact will reach a high of 5,170 jobs and €392 million in GDP in 2023.

Chapter 3 documents the forecast loss of traffic due to the operating restrictions that are attached to the grant of permission for North Runway and that would apply at Dublin Airport when that runway becomes operational. This loss of traffic will result in less employment and economic activity at the airport, and in the upstream industries supporting the airport, as there will be fewer flights and passengers to service.

4.1 Implications for the Economy

The economic impacts will extend across the entire economy, due to the lower connectivity that Dublin Airport would be able to offer:

The restrictions will impact on the post-COVID recovery. The COVID-19 outbreak had a devastating impact on the global economy – the IMF estimates that global GDP declined by 3.3% in 2020 and European Union GDP by 6.1%.[24] Ireland was one of the few European countries to register positive GDP growth in 2020, growing by 3.4%.[25] However, this was largely due to exports of pharmaceuticals and IT by multinationals. Stripping out the effects of multinational companies, *Modified Domestic Demand* registered a 5.4% decline. Notably, the Distribution, Transport, Hotels & Restaurants sector contracted by 16.7% and Construction decreased by 12.7%. There was also a sharp decline in nights spent in tourist accommodation, with a fall of 70% compared with 2019.[26] Within Europe, only Malta and Greece saw sharper drops.

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[24] https://www.imf.org/en/Publications/WEO/Issues/2021/03/23/world-economic-outlook-april-2021.

[25] https://www.cso.ie/en/csolatestnews/pressreleases/2021pressreleases/pressstatementquarterlynationalaccountsquarter42020andyear2020preliminaryandinternationalaccountsquarter42020/.

[26] https://www.irishtimes.com/business/economy/ireland-only-eu-economy-to-grow-in-2020-1.4482192.

The economic recovery will depend on the Irish economy fully re-opening for business, and aviation will play an important role in this regard. Aviation is a major employer in its own right and also facilitates many other sectors of the economy. Any restrictions on air connectivity at Dublin Airport during this recovery period will have a knock-on effect on these other sectors of the economy: business travel will be more restricted and costly, tourism will be hampered, and the hub benefits of Dublin Airport will be diminished.

Restricted early morning departures to Europe will hamper business connectivity. As discussed in Chapter 3, a significant reduction in services and traffic to Europe is expected. The operating restrictions will significantly hamper the ability of Dublin-originating passengers to arrive at European destinations in the morning and conduct same-day trips to Europe. With Europe one to two hours ahead of Ireland, it is necessary to take a very early morning flight from Dublin Airport in order to arrive close to the start of the business day. For example, a 05:55 flight from Dublin will arrive at Frankfurt at 08:55 local time. The need for early morning flights is even more pronounced for Eastern Europe due to the longer distances involved and the greater time difference. With reduced availability of early morning flights, some business travellers would need to depart the day before, incurring significant additional accommodation/subsistence costs for businesses, as well as loss of employee productivity. Some travellers may be forced to cancel their trip entirely.

This will put Irish businesses at a competitive disadvantage to businesses located in regions with less restricted access to air services. It will also make the Republic of Ireland a less attractive location to base international businesses, especially those seeking a base for their European operations.

In the last ten years there has been a significant change in business travel patterns. People now want to make same day business trips and this necessitates more capacity in the early morning and late evening peaks. As an example, the overall percentage of business passengers at Dublin Airport is 18% (in 2018). However, this starts to increase at 5AM, peaking at 19% between 5AM and 6AM. The percentage of business passengers starts to fall after 9AM.[27] From a business perspective, 70% of business owners in Ireland believe that a flight schedule facilitating arriving in time for the start of the business day is important. Only one in five believe it is not important.[28]

Reduced long haul connectivity will impact business and tourism. Long haul arrivals moved out of the night period will arrive too late to connect with the short haul departures to Europe. Since long haul services are often dependent on connecting traffic to achieve sustainable traffic loads, this could impact on the viability of long haul services. This is compounded by short haul flights departing Dublin Airport later in the morning and so unable to return in time to efficiently connect passengers on the long haul service's return flight.

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[27] Source: Dublin Airport Passenger Tracker.

[28] Source: Behaviours & Attitudes Business Barometer Survey. http://banda.ie/techniques/business-to-business-barometer/

Any reduction in long haul services will make Ireland a more difficult destination to visit for some tourists and will reduce its attractiveness for businesses considering locating or investing in Ireland.

The operating restrictions will hamper Dublin's ability to develop as a hub airport. Hub airports create economies of scale by pooling both point-to-point traffic (traffic originating or terminating at Dublin) with transferring traffic (passengers connecting between aircraft at Dublin enroute to their final destination). The benefit of attracting transfer traffic is that air services can be supported that could not be sustained on the basis of point-to-point traffic. For example, an air service to a secondary destination in the United States may only be viable through the inclusion of transfer traffic. All major hub airports have a substantial proportion of transfer traffic; some, such as Frankfurt, have more than 50% transfer traffic. However, restrictions on night and early morning operations, as described above, will hamper Dublin's ability to act as a hub, by reducing opportunities for convenient transfers. Competition for transfer traffic is strong – transfer traffic can move to any convenient airport in Europe (or elsewhere). The operational restrictions will place Dublin at a considerable competitive disadvantage.

The range of destinations connected to Ireland will be reduced. The analysis described in Chapter 3 also determined that there would be a reduction in the number of destinations served on a non-stop basis. This reduces the number of source markets directly connected to Dublin from which Ireland can attract tourists and the markets that Ireland can easily connect to for trade and business development.[29]

Air fares could increase. The restricted night operations will limit the number of hours some aircraft can be operated, potentially reducing aircraft utilisation and, as a result, lead to higher unit costs. These higher costs may be passed onto passengers or result in lower route profitability, with implications for service viability. Furthermore, the limited availability of early morning slots could limit airline competition at these times, potentially resulting in higher fares.

Airlines may base aircraft outside of Ireland. Airlines based at Dublin, currently Aer Lingus and Ryanair, may seek to base some aircraft at airports without night restrictions in order to improve aircraft utilisation. Ryanair, in particular, has a wide range of bases located across Europe. This will reduce the economic activity associated with the aviation sector in Ireland (e.g., aircraft maintenance, air crew employment, etc.).

Air cargo will be impacted. Many air cargo operations occur during the night, including those by package integrators such as DHL, TNT and FedEx operating to their main sortation hubs. These operations are very time-critical in order to connect at these hubs and to achieve an overnight package delivery service. A recent study found that 38% of Dublin's air freight was flow at night and that 63% of night air cargo is transported by

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[29] These markets can still be accessed through connecting air services, but these are less attractive and more time consuming.

express freight operators primarily shipping time sensitive goods.[30] The loss of air cargo services due to the night restrictions will impact Ireland's trade and supply chain competitiveness.

The operating restrictions will impact trade, tourism, investment and competitiveness. As documented in Chapter 1 and Appendix B, air connectivity facilitates the business of other sectors of the economy. Air service facilitates the arrival of larger numbers of tourists to a region or country, whose spending benefits hotels, restaurants and a wide range of other tourism businesses. Aviation also facilitates trade in both goods and services. For example, a recent study in the UK found that a 10% increase in seat capacity increased goods exports by 3.3% and goods imports by 1.7%.[31]

Air connectivity is important in attracting international business' headquarters and foreign investment into a country. A key factor many companies take into account when making decisions about the location of offices, manufacturing plants or warehouses is proximity of an international airport. A survey by IATA found that 30% of Chinese firms reported that they had changed investment decisions because of constraints on air services.[32]

Therefore, limiting the connectivity of Dublin Airport through the operating restrictions will have implications for the wider economy, as quantified in **Section 4.3**.

4.2 Implications for Irish National Aviation Policy

In August 2015, the Department of Transport, Tourism and Sport published a National Aviation Policy for Ireland.[33] The development of the policy document began in December 2012, with the purpose of providing a policy framework for the country's aviation sector and to enable the industry to remain competitive in the global market. In particular, the National Aviation Policy has the following key goals:

- **Enhance Ireland's connectivity** – respond to the needs of businesses, tourism and consumers through safe, secure and competitive access;
- **Foster growth of aviation enterprise** – support employment in the sector and maintain Ireland's strong tradition and reputation in aviation;
- **Maximise economic contribution of aviation sector** – commit to maximising the benefits of aviation to Ireland's economic growth and development.

In order to achieve these goals, specific policies and actions are provided in the document that aim to encourage increased services to and from Ireland. This includes creating conditions that support the development of new routes and services to new and emerging markets. The National Aviation Policy also commits that airlines operating in the Irish

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[30] "The Economic Impact of Cargo Night Flying at Dublin Airport", Freight Transport Association Ireland, March 2020.

[31] PWC, "Econometric Analysis to Develop Evidence on the Links Between Aviation and the Economy", Report for the UK Airports Commission, December 2013.

[32] "Airline Network Benefits", IATA Economic Briefing No. 3, 2006.

[33] Ireland Department of Transport, Tourism and Sport, A National Aviation Policy for Ireland, August 2015.

market will have a high level of competition. Furthermore, to enhance connectivity, the national policy seeks to optimise the Irish airport network to benefit air travellers, businesses and tourism. To compete effectively in the global market, the regulatory framework needs to reflect best international practices and facilitate continued investment in aviation infrastructure.

In regard to the second runway at Dublin Airport, the National Aviation Policy specifically states that:

> *"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".*
>
> A National Aviation Policy for Ireland, August 2015, Action 4.5.1, page 50.

Based on the impacts of the operating restrictions on passenger traffic and air services described in Chapter 3, it is clear that the operating restrictions at Dublin Airport contradict the aims and commitments of the National Aviation Policy, with both passenger traffic and air services reduced. The negative effects on both long haul and short haul flights in the constrained schedule also reduce the connectivity and competitiveness of Dublin Airport. Consequently, the decreased traffic and air services due to the operating restrictions result in forgone employment and economic contribution to the national economy, as described in more detail and quantified in the section below.

4.3 Forgone Economic Impact Estimates

The forgone economic impact associated with the operating restrictions was estimated using the methodology described in Section 2.2, the future economic impact was estimated based on forecast traffic, with adjustments to allow for the impact of COVID-19, and of productivity improvements and economies of scale. The methodology was applied to the forecasts without the operating restrictions (unconstrained) and the forecasts with the restrictions (constrained). The forgone economic impact was then calculated by subtracting the economic impact under the constrained forecast from the economic impact under the unconstrained forecast.

The resulting estimates of forgone economic impact in 2022, 2023, 2024 and 2025 are presented in **Figure 4-1**. The analysis suggests that as a result of the operating restrictions, the Irish economy could forgo an additional 5,170 jobs and €392 million in GDP by 2023, relative to unrestricted night operations with the proposed noise mitigation measures. The forgone economic impact is projected to reduce after 2023 as the 32 million cap on passengers starts to reduce the gap between the forecast scenarios. By 2025, the forgone economic impact is estimated to be 4,120 jobs and €314 million in GDP.

The majority of this forgone economic impact is expected to occur outside of the aviation sector: 62% of the total impact is catalytic impacts (tourism, trade, investment, etc.) and another 21% are indirect and induced impacts (supplier and spending in the wider economy).[34] This forgone economic impact is approximately 3% of the total projected economic impact of Dublin Airport in 2025 – in other words, the economic contribution of Dublin Airport will be reduced by 3% due to the operating restrictions. To put this into context, the number of jobs forgone at its peak in 2023 is higher than the total employment of either Google or Facebook in Ireland.[35]

[34] Based on 2023 forgone impacts.

[35] Source: The Irish Time Top 1000: Google – 3,300; Facebook – 4,500.

Figure 4-1: Forgone Economic Impact Resulting from Operating Restrictions

Impact	Number of Jobs	Full-Time Equivalents (FTEs)	Wages (€ Millions)	GVA (€ Millions)
2022 Impact				
Direct	630	560	26	52
Indirect	360	320	15	29
Induced	440	390	15	31
Catalytic	3,130	2,760	119	234
Total	**4,560**	**4,030**	**175**	**345**
2023 Impact				
Direct	820	730	34	68
Indirect	480	420	20	38
Induced	580	510	20	40
Catalytic	3,290	2,910	126	246
Total	**5,170**	**4,570**	**199**	**392**
2024 Impact				
Direct	740	660	30	61
Indirect	430	380	18	34
Induced	520	460	18	36
Catalytic	2,850	2,520	109	213
Total	**4,540**	**4,020**	**175**	**345**
2025 Impact				
Direct	760	680	31	63
Indirect	440	390	18	35
Induced	530	470	19	37
Catalytic	2,390	2,110	91	179
Total	**4,120**	**3,650**	**159**	**314**

All financial figures are in 2020 prices.
Numbers may not add up due to rounding.

Based on the current distribution of jobs and economic impact, the forgone economic impact by region has been estimated and provided in **Figure 4-2** for 2023 and 2025. It is anticipated that a significant proportion of this forgone economic impact will be felt in the Fingal region, with 89% of the forgone direct employment and at least 25% of the forgone total employment (direct, indirect, induced and catalytic impacts) located in Fingal.

Figure 4-2: Regional Breakdown of the Forgone Economic Impact

2023

Region	Direct	Indirect	Induced	Catalytic	Total	% Share of Total
Employment (Jobs)						
Dublin Airport / Fingal	720	150	120	300	1,290	25%
Rest of Dublin	60	190	180	730	1,160	22%
Rest of Leinster	20	80	130	910	1,140	22%
Rest of Ireland	20	60	150	1,350	1,580	31%
Total	**820**	**480**	**580**	**3,290**	**5,170**	**100%**
GVA (€ Millions)						
Dublin Airport / Fingal	60	12	9	28	109	28%
Rest of Dublin	5	15	13	65	97	25%
Rest of Leinster	1	6	9	62	78	20%
Rest of Ireland	2	5	10	92	109	28%
Total	**68**	**38**	**40**	**246**	**392**	**100%**

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2025

Region	Direct	Indirect	Induced	Catalytic	Total	% Share of Total
Employment (Jobs)						
Dublin Airport / Fingal	670	140	110	220	1,140	28%
Rest of Dublin	60	170	170	530	930	23%
Rest of Leinster	10	70	110	660	850	21%
Rest of Ireland	20	60	140	980	1,200	29%
Total	**760**	**440**	**530**	**2,390**	**4,120**	**100%**
GVA (€ Millions)						
Dublin Airport / Fingal	56	11	8	20	96	30%
Rest of Dublin	5	14	12	47	77	25%
Rest of Leinster	1	6	8	45	59	19%
Rest of Ireland	2	4	10	67	82	26%
Total	**64**	**35**	**37**	**179**	**315**	**100%**

All financial figures are in 2020 prices.
Numbers may not add up due to rounding.

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Appendix A: Further Information on the Input-Output Tables and the Economic Multipliers

As described in Chapter 2, the economic impact multipliers (indirect and induced) impacts were based on an Input-Output (I-O) model of the economy of the Republic of Ireland maintained by the Central Statistics Office Ireland.

The I-O model output was used to estimate the direct, indirect and induced economic effects in this study. This approach has been widely accepted as the most comprehensive approach for the study of economic impact.

The Input-Output Model

The I-O model of an economy links the gross output of an industry to the final demand for that industry and to the intermediate demands made by other sectors for its output. **Figure A-1** illustrates the basic structure of the input-output model.

Figure A-1: A Highly Simplified Input-Output Accounting Framework

	Industries (Purchases)	Final Demand	Total Output
Industries (Sales)	Z	Y	X
Value-added (primary inputs)	V		
Total output	X		

Analytically, we have the following basic identity for sector *i*,

$$X_i = Z_{i1} + Z_{i2} + \cdots + Z_{in} + Y_i, \quad i = 1, \cdots, n. \quad (1)$$

In **Figure A-1**,

- The first row characterizes the “purchasing sectors” (purchasers), while the first column captures the “selling sectors” (sellers);
- Each data column under “Industries” represents the sales from other sectors to sector i; that is, sector i’s purchases of the products of various producing sectors in the economy. Hence the column represents the sources and magnitudes of sector i’s inputs.
- On the other hand, in engaging in production, a sector also pays for other items – for example, labor and capital – and uses other inputs as well, such as inventoried items.

All of these together are termed the value-added in sector i. In addition, imported goods may be purchased as inputs by sector i. All of these inputs (value added and imports) are lumped together as purchases from what is called the payments sector (Vi in Figure A-1).

In the case of Ireland, the net final demand (Y) is the sum of the following items:

- Final consumption of households;
- Government consumption expenditure;
- Gross capital formation;
- Change in inventory; and
- Exports.

For Ireland, the total value-added (V) is the sum of the following items:

- Imports of goods and services;
- Operating surplus;
- Compensation of employees;
- Consumption of fixed capital;
- Product and other indirect taxes less subsidies.

In other words, referring back to Figure A-1, each row for sector i=1 to n records the sales of that sector's output to other industrial sectors in the economy plus sales to private consumers, government, capital formation, inventory and overseas purchasers. Each column for sector i=1 to n records the purchases of production inputs for that sector in order to produce its total output. This includes purchases from other sectors of the economy, purchases of imports, payment for labour, payment of government taxes, and generation of profits.

Input-Output Coefficients

Input-output table becomes an economic tool when Leontief introduced an assumption of fixed-coefficient linear production functions related to input used by a sector along each column to its output flow, i.e., for one unit of every industry's output, a fixed amount of input of each kind is required.[36] That is, we define the following coefficients:

$$a_{ij} = \frac{Z_{ij}}{X_j}.$$

This ratio is termed a technical coefficient, commonly known as input-output coefficient or direct input coefficient. With this specification of production technology, the model basically assumes that the industry shows constant returns to scale, which is a reasonable approximation in short-run, but nevertheless is also a limitation of the model.

36 See Leontief, Wassily W. *Input-Output Economics*. 2nd ed., New York: Oxford University Press, 1986.

Once the notion of a set of fixed input-output coefficients is accepted, the system of equations (1) can be represented as follows:

$$X_i = a_{i1}X_1 + a_{i2}X_2 + \cdots + a_{in}X_n + Y_i, \quad i = 1, \cdots, n. \quad (2)$$

This leads to the matrix representation:

$$\boldsymbol{X} = \boldsymbol{A}\,\boldsymbol{X} + \boldsymbol{Y} \qquad (3)$$

Hence, with the net final demand vector ***Y***, we can solve for the output vector, via matrix inverse as follows:

$$\boldsymbol{X} = (\mathbf{I} - \boldsymbol{A})^{-1}\,\boldsymbol{Y} \qquad (4)$$

where **I** stands for the identity matrix. And the matrix $(\mathbf{I} - \boldsymbol{A})^{-1}$ is the Leontief inverse coefficients. These measure the total amount of output in each sector that is required to be produced in order to satisfy the direct and indirect demands produced by one unit increase in the final demand for a given sector (i.e., the direct + indirect multiplier). The economic interpretation of the Leontief inverse coefficients is consistent with the derivation of the Keynesian multipliers (e.g., expenditure multiplier) that are commonly used in macroeconomics. In other words, it can be interpreted as a result of successive rounds of iterations. An important implication of this connection with the Keynesian multiplier is that the inverse coefficients capture both direct and indirect effects of the final demand from all sectors identified in the I-O table. In practice the multipliers from I-O tables are usually expressed in values so that coefficients measure the requirements in dollars on sector i when sector j increases its final demand by one dollar.

Indirect and Induced Impacts - Open System and Closed System

The economic impact multipliers are expressed as ratios that measure the impact on the total economy as a result of an initial autonomous change in any of the final demand components. The action of the multiplier can be illustrated by the sequence of events that follow after the initial autonomous change. Different kinds of multiplier can be generated depending on the purpose of analysis. The common multipliers used are output, valued-added, employment, and income multipliers. For comparative purposes, multipliers use usually expressed with respect to a unit of autonomous change in final demand.

Open Model: Direct and Indirect Impacts

Each of the multipliers listed above can be generated from two different models: *open* and *closed*. The intrinsic difference between them is the treatment of household income and personal consumption expenditure. In the *open* model, all final demand components are assumed to be exogenous. Hence the *open* model captures the production-induced effects resulting from a change in final demand. The multipliers generated using the open model are also known as simple multipliers or Leontief multipliers. This kind of model is described as *open* because at each round of the multiplier process, there is leakage from the system. The leakage consists of payments for imports and primary inputs and the recipients are assumed to make no use of their receipts. Even if a small part of the receipts were spent on goods and services, there would be further multiplier repercussions. In our analysis, Leontief multipliers capture the direct and indirect effects of an autonomous change in final demand.

Closed Model: Direct, Indirect and Induced Impacts

Conversely, in the *closed* model, the household sector is treated as endogenous to the system. The household sector receiving income from the work done in the production process would spend some of this income on local products. This increase in consumption would in turn increase the level of output of the products. In other words, the *closed* model accounts for both the production-induced effects as well as the consumption-induced effects. The multipliers generated using the *closed* model are commonly known as the total multipliers or Leontief-Keynes multipliers. In our analysis, Leontief-Keynes multipliers will capture the direct, the indirect AND the induced effects.

The total multiplier from the closed model is by definition larger than the simple multiplier from open model. The difference between the two multipliers is the induced impact.

Appendix B: Overview of Catalytic Impacts

As discussed in Chapter 1, catalytic impacts capture the way in which aviation facilitates the business of other sectors of the economy. This comprises:

- **Tourism** – air service facilitates the arrival of larger numbers of tourists to a country. This includes business as well as leisure tourists. The spending of these tourists can support a wide range of tourism-related businesses: hotels, restaurants, entertainment and recreation, car rentals, and others.
- **Trade** – air transport provides connections to export markets for both goods and services.
- **Investment** – a key factor many companies take into account when making decisions about the location of offices, manufacturing plants or warehouses is the proximity of an international airport.
- **Productivity** – air transportation offers access to new markets which in turn enables businesses to achieve greater economies of scale. Air access also enables companies to attract and retain high quality employees.

A number of studies have demonstrated that air transportation plays an important role in trade, investment and business location decisions, while additional studies have uncovered empirical evidence demonstrating a strong linkage between air service and employment and economic growth. Provided below is a summary of this research examining the catalytic impact of aviation, taken from academic and industry research.

Trade

A number of research papers have produced evidence that aviation positively contributes to the trade of both goods and services

Paper	Methodology	Key Findings
Cech (2004)[37]	Used a cross-section statistical comparison method to investigate how air cargo services affect the economies of 125 U.S. counties.	Higher levels of air cargo services contribute to increased earnings and increased employment.
EUROCONTROL (2005)[38]	The study estimated the net contribution of air transportation to trade (i.e., export minus imports).	Net contribution of air transportation to trade was €55.7 billion in 2003 across the 25 current EU members.

[37] Cech P. (2004), "The Catalytic Effect of the Accessibility to Air Cargo Services", TIACA Graduate Research Paper Competition.

[38] Cooper, A. and Smith, P. (2005), "The Economic Catalytic Effects of Air Transport in Europe," Commissioned by EUROCONTROL. EUROCONTROL is a civil and military organisation established in 1963 to facilitate a safe, seamless pan-European Air Traffic Management (ATM) system.

Paper	Methodology	Key Findings
UK Institute of Directors (2008)[39]	Surveyed 500 UK businesses about their use and the importance of air transportation.	The use of air travel strongly linked to business trade and sales. Almost three quarters of businesses using passenger air services said that their business would be adversely affected if the amount of air travel they could undertake was significantly curtailed.
Poole (2010)[40]	Econometric analysis of U.S. trade and travel data from 1993 to 2013.	A 10% increase in business travel to the U.S. by non-residents led to a 1.2% increase in the volume of exports from the U.S. and 0.3% increase in export margins. The effect was strongest for travel from non-English speaking countries, suggesting that business travel help overcome language barriers in trade relationships.
PWC (2013)[41]	Examined the relationship between the UK's international air seat capacity and international trade, controlling for other factors affecting trade.	A 10% increase in seat capacity increased goods exports by 3.3% and goods imports by 1.7%.

Investment and Business Location

The impact of aviation on investment and business location decisions has been the subject of a number of papers. These papers have found evidence of air connectivity contributing to increased investment and beneficial location decision for the surrounding regions or the country.

[39] UK Institute of Directors (2008), "High Fliers: Business Leaders' View on Air Travel", http://www.iod.com/MainWebSite/Resources/Document/policy_paper_high_fliers.pdf
[40] Poole, J. (2010), "Business Travel as an Input to International Trade", http://www.scu.edu/business/economics/upload/Poole.pdf

[41] PWC (2013), "Econometric Analysis to Develop Evidence on the Links Between Aviation and the Economy", Report for the UK Airports Commission, December 2013.

Paper	Methodology	Key Findings
Hansen and Gerstein (1991)[42]	Used data from 1982 to 1987, the analysis related the amount of Japanese investment in each US state to measures of level of air service operated between Japan and that state (and other background factors).	The amount of Japanese investment in each US state was causally linked to the air service between Japan and that state.
EUROCONTROL (2005)[43]	Analysed the relationship between air transportation and business investment in the EU.	A 10% increase in air transportation usage increases business investment by 1.6% in the long run (the impact takes approximately five years to fully manifest).
IATA (2005)[44]	IATA surveyed 625 businesses in five countries (China, Chile, United States, Czech Republic and France).	25% of surveyed businesses in five countries indicated that 25% of their sales were dependent on good air transport links; 30% of Chinese firms reported that they had changed investment decisions because of constraints on air services.
Bel and Fageda (2008)[45]	Statistically analysed the relationship between international air service and the location of large firm's headquarters across major European urban areas.	A 10% increase in supply of intercontinental air service was associated with a 4% increase in the number of large firm headquarters located in the corresponding urban area.

[42] Hansen, M. and R. Gerstein "Capital in Flight: Japanese Investment and Japanese Air Service in the United States During the 1980s," Logistics and Transportation Review, 1991, Vol. 27, No. 3, pp. 257-276.

[43] Cooper, A. and Smith, P. (2005), "The Economic Catalytic Effects of Air Transport in Europe," Commissioned by EUROCONTROL. EUROCONTROL is a civil and military organisation established in 1963 to facilitate a safe, seamless pan-European Air Traffic Management (ATM) system.

[44] *Airline Network Benefits*, IATA Economic Briefing No. 3, 2006.

[45] Bel, G. and Fageda, X. (2008), "Getting There Fast: Globalization, Intercontinental Flights and Location of Headquarters", Journal of Economic Geography, Vol. 8, No. 4.

Paper	Methodology	Key Findings
Arndt et al. (2009)[46]	Survey of 100 foreign-owned businesses in Germany.	Air connectivity was one of the four most important factors affecting location decisions, and that 57% of businesses would have chosen another location had connectivity been less good.
PWC (2013)[47]	Econometric analysis of the UK's air connectivity, air seat capacity and Foreign Direct Investment (FDI).	A 1% increase in international seat capacity was associated with a 0.47% increase in FDI inflows and a 0.19% increase in FDI outflows.

Impact on Employment, Economic Growth and Productivity

The increased trade, investment, business activity and tourism facilitated by aviation ultimately results in increases in economic productivity (e.g., GDP per worker), in GDP and in employment (e.g., increased trade facilitated by air services results in increased employment in the businesses producing the traded goods and services). A number of research papers have examined the overall impact on the economy and employment as a result of the catalytic effects of aviation.

Paper	Methodology	Key Findings
Button, Lall, Stough and Trice (1999)[48]	Used data from 321 US metropolitan areas in 1994 to regressed high-tech employment against a number of controlling factors including a dummy indicating that the region was served by a hub airport.	The analysis found that the presence of a hub airport increased high-tech employment by an average of 12,000 jobs in a region.

[46] Arndt, A., et al. "Economic catalytic impacts of air transport in Germany–The influence of connectivity by air on regional economic development." ATRS Conference. 2009.

[47] PWC (2013), "Econometric Analysis to Develop Evidence on the Links Between Aviation and the Economy", Report for the UK Airports Commission, December 2013.

[48] Button, K., Lall, S., Stough, R. and Trice, M. (1999), "High-technology employment and hub airports," Journal of Air Transport Management, Vol. 5, Issue 1, January 1999.

Paper	Methodology	Key Findings
Button and Taylor (2000)[49]	Used data for 41 metropolitan areas in the US to regress "new economy" employment against a number of control factors including the number of direct routes to Europe offered by airports in the region.	Increasing the number of routes between the US and Europe from 3 to 4 at an airport generated approximately 2,900 "new economy" jobs in the surrounding region.
Brueckner (2002)[50]	Regressed employment in 94 metropolitan areas in the US against a number of factors including measures of air service.	A 10 percent increase in passenger enplanements in a metropolitan area leads to an approximately 1 percent increase in employment in service-related industries.
Ishutkina and Hansman (2009)[51]	Aggregate and individual country-level data were analysed in terms of the relationship between air transportation passengers and GDP. A data analysis of 139 countries over a time period of 30 years (1975 to 2005).	Found statistical evidence of a (two-way) feedback relationship between air transport and economic activity.
PWC (2013)[52]	Estimated an Error Correction Model of UK GDP and air seat capacity between 1991 and 2010.	A 10% change in the growth rate of seat capacity leads to approximately a 1% change in the growth rate of GDP. The analysis also found evidence of a two-way relationship between the variables – GDP growth causes seat capacity and seat growth causes GDP growth.
ACI Europe/ Inter*VISTAS* (2015)	Analysed the relationship between national air connectivity and GDP per capita using data for 40 European countries between 2000 and 2012.	This recently completed analysis found that a 10% increase in connectivity was associated with an increase in GDP per capita of 0.6%. Additional analysis found evidence that this relationship was two-way.

[49] Button, K. and Taylor, S. (2000), "International air transportation and economic development", *Journal of Air Transport Management*, Vol. 6, Issue 4, October 2000.

[50] Brueckner, J. (2002), "Airline Traffic and Urban Economic Development".

[51] Ishutkina M.A. and Hasnman R.J. (2009), "Analysis of the interaction between air transportation and economic activity: a worldwide perspective", PhD thesis, Department of Aeronautics and Astronautics, Massachusetts Institute of Technology.

[52] PWC (2013), "Econometric Analysis to Develop Evidence on the Links Between Aviation and the Economy", Report for the UK Airports Commission, December 2013.

Paper	Methodology	Key Findings
		That is, as an economy grows, it supports a larger air transport sector, but it appears to also be the case that growth in air transport supports economic growth.
Baker, Merkert and Kamruzzaman (2015)[53]	Analysed 88 regional airports in Australia over a period of 1985–86 to 2010–11 to determine the catalytic impacts of regional air transport on regional economic growth.	A significant bi-directional relationship was established: airports have an impact on regional economic growth and the economy directly impacts regional air transport.

Conclusions

A body of research has developed over the last 15-20 years which has examined and quantified the contribution of air transport to trade, investment and economic growth. Through the use of different empirical methods and data sets, this research has consistently found a significant and positive relationship between aviation and economic growth. Furthermore, much of the research has established that air transport growth has been the *cause* of economic growth, rather than simply economic growth leading to increased air transport levels.

53 Baker, D., Merkett, R. and Kamruzzaman, M. (2015), "Regional aviation and economic growth: cointegration and causality analysis in Australia", Journal of Transport Georgraphy, Vol. 43, February 2015, pp. 140-150.

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Appendix 3B. Crosswind Runway Information

Document Classification: Class 1 - General

Crosswind Runway Information

Requested by ANCA RFI Appendix A, Request H and Table 4 Items 79, 80 and 81

May 25, 2021

ANCA RFI, Appendix A – Summary, Request H

The Aircraft Noise Competent Authority (ANCA) issued a Request for Information (RFI) in relation to Planning Application F20A/0668 submitted by daa on December 18th, 2020. The RFI, contained in Appendix A to the ANCA information request letter, includes items related to the use of Runway 16-34 (crosswind runway) detailed in Request H.

The Request H items are further clarified in Table 4 of Appendix A, Request Numbers 79, 80, and 81. Request H and the three Table 4 items are detailed below.

APPENDIX A, REQUEST H

For ANCA to fully understand the reliance and relevance of the crosswind runway on the forecasts provided, the following information is requested:

- Clarification of whether the use of the crosswind runway is primarily due to prevailing wind directions or a result of capacity constraints in the period 0600-0700 associated with the existing main runway. The Applicant is requested to provide analysis to demonstrate any capacity issues using data for 2018 and 2019
- Evidence to support the assumption that the crosswind runway will be used for less than 1% of ATM's. The Applicant is requested to provide data demonstrating its use over the last 10 years due to weather and/or capacity constraints.
- Confirmation whether the crosswind runway, under the current planning permission is used to respond to demand in the hour 0600-0700?

TABLE 4 – NOISE-LED INFORMATION REQUESTS

Request No. 79:

ANCA notes that use of the cross runway is indicated during morning periods, as required. The Applicant is requested to clarify whether the use of the crosswind runway is primarily due to prevailing wind directions or a result of capacity constraints in the period 0600-0700 associated with the existing main runway? The Applicant is requested to provide analysis to demonstrate any capacity issues using data for 2018 and 2019.

Request No. 80:

The Applicant is requested to provide evidence to support the assumption that the crosswind runway will be used for less than 1% of ATM's. The Applicant is requested to provide data demonstrating its use over the last 10 years due to weather and/or capacity constraints.

Request No. 81:

The Applicant is requested to confirm whether the crosswind runway, under the current planning permission is used to respond to demand in the hour 0600-0700.

Methodology Overview

Requests No. 79 and 80

ANCA Requests 79 and 80 seek information on the historical utilisation of Runway 16-34 to quantify the number of aircraft movements by purpose and to confirm the basis for the 1% utilisation assumption detailed in Section 2.5 of the EIAR.

DATA SOURCES

The following data was collected and analysed to prepare the requested information:

- **Dublin Airport Aeronautical Information Publication (AIP)**
  Source: IAA
  (http://iaip.iaa.ie/iaip/Published%20Files/AIP%20Files/AD/EI_AD_2_EIDW_EN.pdf)
- **Dublin Airport operational records** detailing aircraft movements by runway and time for the ten-year period from January 1, 2010 to December 31, 2019.
  Source: daa.
- **Meteorological Terminal Air Report (METAR) data**, detailing recorded wind speed and direction for Dublin Airport from January 1, 2010 to December 31, 2019. Data was reported hourly until mid-2013 and by half-hour thereafter.
  Source: U.S. National Centers for Environmental Information (NCEI), Integrated Surface Data (ISD) digital data set DSI-3505 (https://www.ncei.noaa.gov/access/search/data-search/global-hourly)

DATA ANALYSIS (1 of 4)

The **Dublin Airport AIP** was reviewed to identify published requirements for utilisation of Runway 16-34 due to crosswinds on Runway 10-28. See following page for details.

Dublin Airport operational records were analysed to:

- Remove non-runway movement data, such as repositioning of aircraft on the ground, and helicopter operations.
- Quantify arrival and departure movements by runway by 30-minute period for January 1, 2010 to December 31, 2019.

METAR data was analysed to:

- Calculate the crosswind component acting on each runway during each 30-minute period. Where data was reported on an hourly basis, the hourly value was applied to the corresponding two 30-minute periods.
- The crosswind component was calculated for wind gusts (fluctuating winds that exceed sustained wind speed by 10 knots or more) when present in the METAR data.
- METAR data is reported in Coordinated Universal Time (UTC). METAR time was mapped to local time to match the Dublin Airport operational data.
- A small number of hours had missing or incomplete data and these were coded as unknown.

Methodology Overview

Requests No. 79 and 80

DATA ANALYSIS (2 of 4)

METAR and Dublin Airport operations data was combined and analysed to categorise Runway 16-34 aircraft movements as follows:

Category 1: Operational Efficiency

Dublin Airport is a coordinated airport. Schedules are determined by a coordinator appointed by the Commission for Aviation Regulation (CAR) based on a determination of available slot capacity. The capacity limits are established for Runway 10-28 as the primary runway and do not include capacity that could be provided on Runway 34 during westerly operations, but not during easterly operations. The capacity limits applied for Runway 10-28 permit the allocation of scheduled slots to a level that would result in a maximum average 10-minutes delay per movement in each hour if all slots are utilised.

During normal westerly operations, Runway 34 is typically utilised in addition to Runway 28 between 0630 and 0800 to provide additional departures capacity to improve airfield operating efficiency, reducing taxiway congestion and delays.

Movements on Runway 34 were classified as Operational Efficiency if, between 0630 and 0800:

- Runway 34 was used for departures only, no arrivals.
- Runway 28 was utilised for most aircraft movements.
- The Runway 10-28 crosswind component was below the Dublin Airport AIP 20-knot limit.

Category 2: Recorded Crosswind Conditions

Movements on Runway 16-34 during periods when the recorded crosswind component exceeded 20 knots, as specified in the Dublin Airport AIP (see **Exhibit 1**). The crosswind component represents the force acting perpendicular to the alignment of the runway and is calculated from wind speed and direction recorded in the METAR data.

Exhibit 1: AIP Runway Use for Crosswind Conditions[1/]

Dublin Airport Aeronautical Information Publication

Section AD 2.21-5

Runway 10R or 28L is the required Runway between 0600 and 2300HR Local Time when the crosswind component is 20KT or less. Runway 28L will be the preferential Runway when the tailwind component is 10KT or less and braking action is assessed as good. Aircraft will be required to use these Runways except when operational reasons dictate otherwise.

If the crosswind component on Runway 10R or Runway 28L is greater than 20KT Runway 16 or Runway 34 may become the active Runway. If the forecast crosswind component on Runway 10R or 28L is greater than 20KT Runway 16 or 34 may become the active Runway. The use of Runway 16/34 will be kept to an absolute minimum subject to operational conditions.

1/ The Dublin Airport AIP refers to existing Runway 10-28 as Runway 10R-28L. The runway will be renamed to the AIP designation upon completion of the new North Runway. This report focuses on historical analysis and uses the current designation (Runway 10-28) to refer to the existing south runway.

Methodology Overview
Requests No. 79 and 80

DATA ANALYSIS (3 of 4)

Category 3: Possible Crosswind Related Conditions

The Dublin Airport AIP indicates that Runway 16-34 may become the active runway if the forecast crosswind component on Runway 10-28 exceeds 20 knots. Air Traffic Control (ATC) tactically determines when to switch to Runway 16-34 prior to the development of a crosswind component exceeding 20 knots and when to switch back to Runway 10-28 after the crosswind component has reduced below 20 knots. The analysis classified movements on Runway 16-34 as Possible Crosswind Related if:

- Movements were not classified as Operational Efficiency.
- There was a recorded crosswind component on Runway 10-28 exceeding 20 knots within 6 hours before or after the 30-minute period under evaluation.

ANCA Request No. 80 seeks information supporting the anticipated 1% use of Runway 16-34 for crosswind conditions in the future. The current Dublin Airport AIP (see Exhibit 1) notes that Runway 16-34 use will be kept to an absolute minimum subject to operational conditions. The historical utilisation of the runway during crosswind related conditions was evaluated to determine whether there is a pattern of continuous improvement represented by a decrease in the proportion of aircraft movements on Runway 16-34 within six hours of recorded crosswind components exceeding 20 knots on Runway 10-28, relative to the number of aircraft movements during hours with recorded crosswind components exceeding 20 knots.

This analysis identified a pattern of continuous improvement and developed an estimate for required crosswind utilisation of Runway 16-34 based on the lowest proportion of crosswind related activity achieved during the 2010-2019 period.

Category 4: Maintenance (1 of 2)

Aircraft movements on Runway 16-34 that are not categorised as Operational Efficiency, Recorded Crosswind Condition, or Possible Crosswind Related. These movements are primarily related to closure of Runway 10-28 for either major repair and rehabilitation works or periodic essential maintenance. Major repair and rehabilitation works over the ten-year period from 2010 to 2019 include:

- 2010 – a 6-month period of overnight closures to install an overlay of Runway 10-28
- 2015 – a 2-month period of overnight closures to carry out extensive survey works of Runway 10-28
- 2016-2018 – overnight closures to carry out a full rehabilitation of Runway 10-28

Periodic essential maintenance activities include pavement and lighting maintenance, rubber removal and grass cutting.

Runway 16-34 movements were reviewed to determine whether they were likely to be associated with overnight maintenance-related closure based on the following criteria:

- Runway 16-34 movements occurred for a minimum 3-hour period between 21:30 and 05:30
- No Runway 10-28 movements when Runway 16-34 was active.
- The recorded Runway 10-28 crosswind component was below 20-knots.
- There was no recorded crosswind component on Runway 10-28 exceeding 20 knots within 6 hours before or after the 30-minute period under evaluation.

Methodology Overview

Requests No. 79 and 80

DATA ANALYSIS (4 of 4)

Category 4: Maintenance (2 of 2)

Maintenance-related activities occasionally take place during the day. Runway 16-34 movements were reviewed to determine whether they were likely to be associated with a maintenance-related closure of Runway 10-28 based on the following criteria:

- Runway 16-34 movements occurred for a minimum 3-hour period between 05:30 and 21:30
- No Runway 10-28 movements when Runway 16-34 was active.
- The recorded Runway 10-28 crosswind component was below 20-knots.
- There was no recorded crosswind component on Runway 10-28 exceeding 20 knots within 6 hours before or after the 30-minute period under evaluation.

Category 5: Other

Aircraft movements on Runway 16-34 that were not classified as Operational Efficiency, Recorded Crosswind, Possible Crosswind Related, or Maintenance were classified as Other.

ANCA RFI No. 79

Use of Runway 16-34 During the 0600-0700 Period (1 of 2)

ANCA Request No. 79

NOTES/DOC REF	REQUEST
EIAR Main Report, 2.1.2.6 The Balanced Approach "and the crosswind runway (34) when weather conditions allow during the hours of 0630 – 0800 local time) will cease."	ANCA notes that use of the cross runway is indicated during morning periods, as required. The Applicant is requested to clarify whether the use of the crosswind runway is primarily due to prevailing wind directions or a result of capacity constraints in the period 0600-0700 associated with the existing main runway? The Applicant is requested to provide analysis to demonstrate any capacity issues using data for 2018 and 2019.

ANCA Request Summary

- **Part A**: Clarify whether use of crosswind runway is primarily due to wind conditions or operational efficiency during the 0600-0700 hour.
- **Part B**: Demonstrate 0600-0700 operational efficiency utilisation for 2018 and 2019.

Part A – Response Summary

- **Use of the crosswind runway is primarily for operational efficiency during the 0600-0700 hour.**
- **84%** of Runway 16-34 movements during the 0600-0700 hour in the 10-year period from 2010 to 2019 were for **operational efficiency**.
- See following page for additional discussion of operational efficiency utilisation of Runway 16-34.

Table 1: Runway 16-34 Movements from 0600 to 0700 by Year and Category

	Runway 16-34 Movements by Category					
Year	Operational Efficiency	Recorded Crosswind	Possible Crosswind Related	Maintenance	Other	Total
2010	561	9	44	45	8	667
2011	1039	26	75	41	10	1,191
2012	1,319	54	30	37	3	1,443
2013	888	15	80	12	1	996
2014	826	134	68	24	4	1,056
2015	549	89	108	0	4	750
2016	534	69	84	0	22	709
2017	850	38	70	4	12	974
2018	863	130	137	2	5	1,137
2019	914	30	13	0	4	961
Total	**8,343**	**594**	**709**	**165**	**73**	**9,884**
Percent[1/]	84%	6%	7%	2%	1%	

1/ Percent of Runway 16-34 aircraft movements between 0600 and 0700 over the 10-year period.

ANCA RFI No. 79

Use of Runway 16-34 During the 0600-0700 Period (2 of 2)

ANCA Request No. 79

NOTES/DOC REF	REQUEST
EIAR Main Report, 2.1.2.6 The Balanced Approach "and the crosswind runway (34) when weather conditions allow during the hours of 0630 – 0800 local time) will cease."	ANCA notes that use of the cross runway is indicated during morning periods, as required. The Applicant is requested to clarify whether the use of the crosswind runway is primarily due to prevailing wind directions or a result of capacity constraints in the period 0600-0700 associated with the existing main runway? The Applicant is requested to provide analysis to demonstrate any capacity issues using data for 2018 and 2019.

ANCA Request Summary

- **Part A**: Clarify whether use of crosswind runway is primarily due to wind conditions or operational efficiency during the 0600-0700 hour.
- **Part B**: Demonstrate 0600-0700 operational efficiency utilisation for 2018 and 2019.

Part B – Response Summary

- Runway operations during 0600-0700 periods with Runway 16-34 departures identified as related to operational efficiency in 2018 and 2019 were compared against published declared capacity limits for Runway 10-28.
- Aircraft movement volume increases rapidly during 0600-0630, but generally does not exceed declared capacity. During 0630-0700 combined runway operations generally do exceed the 10-28 declared capacity.
- **Table 2** compares movements during the 0630-0700 period with the declared capacity for Runway 10-28 for a sample one-week period in 2018 and 2019 (Note: because declared capacity is reported per hour, 30-minute declared capacity is assumed to be 50% of hourly declared capacity).
- Movements accommodated on both runways exceed the Runway 10-28 declared capacity in **83%** of the 0630-0700 periods identified as related to operational efficiency in 2018-2019.

Table 2: 0630-0700 Movements and Capacity Limits for Selected 2018/19 Dates

Date	10-28 Arrivals	10-28 Departures	16-34 Arrivals	16-34 Departures	Total Departures	Total Movements	10-28 Departures Limit	10-28 Movements Limit	10-28 Limit Exceeded?
01/07/2018	4	13	0	5	18	22	16	21	Yes
02/07/2018	4	14	0	4	18	22	16	21	Yes
03/07/2018	2	17	0	6	23	25	16	21	Yes
04/07/2018	4	12	0	7	19	23	16	21	Yes
05/07/2018	5	14	0	5	19	24	16	21	Yes
06/07/2018	2	15	0	5	20	22	16	21	Yes
07/07/2018	4	13	0	5	18	22	16	21	Yes
30/06/2019	1	16	0	2	18	19	16	21	Yes
01/07/2019	1	16	0	5	21	22	16	21	Yes
02/07/2019	1	18	0	4	22	23	16	21	Yes
03/07/2019	2	15	0	5	20	22	16	21	Yes
04/07/2019	2	17	0	4	21	23	16	21	Yes
05/07/2019	2	18	0	5	23	25	16	21	Yes
06/07/2019	3	12	0	8	20	23	16	21	Yes

ANCA RFI No. 80

Use of Runway 16-34 from 2010-2019 by Category (1 of 5)

ANCA Request No. 80

NOTES/DOC REF	REQUEST
EIAR Main Report, 2.5 Description of Operations "For the purposes of this EIAR an assumption of use for 1% of aircraft movements was used which is based on the percentage of time it is likely to be essential for use i.e. when the crosswind component requires its use"	The Applicant is requested to provide evidence to support the assumption that the crosswind runway will be used for less than 1% of ATM's. The Applicant is requested to provide data demonstrating its use over the last 10 years due to weather and/or capacity constraints.

ANCA Request

- Demonstrate use of Runway 16-34 over the last 10 years, categorised by crosswind, operational, maintenance, or other.

Response Summary (1 of 5)

- **Total aircraft movements** for the 10 years = **1,921,951**
- **Operational Efficiency** related movements represented an average of **1%** of total movements over the 10-year period.
- **Recorded crosswind:**
  - Aircraft movements on Runway 16-34 that took place during 30-minute periods in which measured wind speed and direction resulted in a **crosswind component on Runway 10-28 exceeding 20 knots**.
  - Runway 16-34 movements during periods when the Runway 10-28 recorded crosswind component exceeded 20 knots represented an average of **0.9%** of total movements over the 10-year period.

Table 3: Runway 16-34 Movements by Year and Category

	Runway 16-34 Movements by Category					
Year	Operational Efficiency	Recorded Crosswind	Possible Crosswind Related	Maintenance	Other	Total
2010	1,158	588	1,340	2,055	336	5,477
2011	1,783	1,494	3,279	2,668	322	9,546
2012	2,349	1,467	1,710	2,145	624	8,295
2013	2,057	1,989	2,793	2,215	419	9,473
2014	2,102	2,408	2,710	1,616	134	8,970
2015	1,484	3,131	2,990	1,779	605	9,989
2016	1,421	1,744	2,069	2,207	556	7,997
2017	2,260	1,447	1,512	8,230	625	14,074
2018	2,291	2,718	2,040	3,048	216	10,313
2019	2,445	1,003	252	926	58	4,684
Total	**19,350**	**17,989**	**20,695**	**26,889**	**3,895**	**88,818**
Percent1/	1.0%	0.9%	1.1%	1.4%	0.2%	4.6%

1/ Percent of total aircraft movements over the 10-year period on both runways.

ANCA RFI No. 80

Use of Runway 16-34 from 2010-2019 by Category (2 of 5)

ANCA Request No. 80

NOTES/DOC REF	REQUEST
EIAR Main Report, 2.5 Description of Operations "For the purposes of this EIAR an assumption of use for 1% of aircraft movements was used which is based on the percentage of time it is likely to be essential for use i.e. when the crosswind component requires its use"	The Applicant is requested to provide evidence to support the assumption that the crosswind runway will be used for less than 1% of ATM's. The Applicant is requested to provide data demonstrating its use over the last 10 years due to weather and/or capacity constraints.

ANCA Request

- Demonstrate use of Runway 16-34 over the last 10 years, categorised by crosswind, operational, maintenance, or other.

Response Summary (2 of 5)

- **Possible crosswind related:**
  - Aircraft movements that took place on Runway 16-34 **within 6 hours of an actual recorded crosswind component** on Runway 10-28 exceeding 20 knots.
  - Runway 16-34 movements within 6 hours of actual crosswind occurrence may be indicative of early switching to Runway 16-34 or late reversion to Runway 10-28 based on forecast crosswinds or may be unrelated to crosswind. See Page 12 for additional analysis of possible forecast crosswind movements.
- **Maintenance** related movements took place on Runway 16-34 due to multi-hour closure of Runway 10-28. **77%** of movements in this category occur during multi-hour periods between 2130 and 0530 hours. The remaining **23%** occur during multi-hour daytime closures of Runway 10-28.

Table 3: Runway 16-34 Movements by Year and Category

Year	Runway 16-34 Movements by Category					
	Operational Efficiency	Recorded Crosswind	Possible Crosswind Related	Maintenance	Other	Total
2010	1,158	588	1,340	2,055	336	5,477
2011	1,783	1,494	3,279	2,668	322	9,546
2012	2,349	1,467	1,710	2,145	624	8,295
2013	2,057	1,989	2,793	2,215	419	9,473
2014	2,102	2,408	2,710	1,616	134	8,970
2015	1,484	3,131	2,990	1,779	605	9,989
2016	1,421	1,744	2,069	2,207	556	7,997
2017	2,260	1,447	1,512	8,230	625	14,074
2018	2,291	2,718	2,040	3,048	216	10,313
2019	2,445	1,003	252	926	58	4,684
Total	**19,350**	**17,989**	**20,695**	**26,889**	**3,895**	**88,818**
Percent[1/]	1.0%	0.9%	1.1%	1.4%	0.2%	4.6%

1/ Percent of total aircraft movements over the 10-year period on both runways.

ANCA RFI No. 80

Use of Runway 16-34 from 2010-2019 by Category (3 of 5)

ANCA Request No. 80	
NOTES/DOC REF **EIAR Main Report, 2.5 Description of Operations** "For the purposes of this EIAR an assumption of use for 1% of aircraft movements was used which is based on the percentage of time it is likely to be essential for use i.e. when the crosswind component requires its use"	**REQUEST** The Applicant is requested to provide evidence to support the assumption that the crosswind runway will be used for less than 1% of ATM's. The Applicant is requested to provide data demonstrating its use over the last 10 years due to weather and/or capacity constraints.

ANCA Request

- Demonstrate use of Runway 16-34 over the last 10 years, categorised by crosswind, operational, maintenance, or other.

Response Summary (3 of 5)

- **Other** aircraft movements on Runway 16-34 that were not classified as Operational Efficiency, Recorded Crosswind, Possible Crosswind Related, or Maintenance were classified as Other.

Table 3: Runway 16-34 Movements by Year and Category

Year	Runway 16-34 Movements by Category					
	Operational Efficiency	Recorded Crosswind	Possible Crosswind Related	Maintenance	Other	Total
2010	1,158	588	1,340	2,055	336	5,477
2011	1,783	1,494	3,279	2,668	322	9,546
2012	2,349	1,467	1,710	2,145	624	8,295
2013	2,057	1,989	2,793	2,215	419	9,473
2014	2,102	2,408	2,710	1,616	134	8,970
2015	1,484	3,131	2,990	1,779	605	9,989
2016	1,421	1,744	2,069	2,207	556	7,997
2017	2,260	1,447	1,512	8,230	625	14,074
2018	2,291	2,718	2,040	3,048	216	10,313
2019	2,445	1,003	252	926	58	4,684
Total	**19,350**	**17,989**	**20,695**	**26,889**	**3,895**	**88,818**
Percent[1/]	1.0%	0.9%	1.1%	1.4%	0.2%	4.6%

1/ Percent of total aircraft movements over the 10-year period on both runways.

ANCA RFI No. 80

Use of Runway 16-34 from 2010-2019 by Category (4 of 5)

ANCA Request No. 80

NOTES/DOC REF	REQUEST
EIAR Main Report, 2.5 Description of Operations "For the purposes of this EIAR an assumption of use for 1% of aircraft movements was used which is based on the percentage of time it is likely to be essential for use i.e. when the crosswind component requires its use"	The Applicant is requested to provide evidence to support the assumption that the crosswind runway will be used for less than 1% of ATM's. The Applicant is requested to provide data demonstrating its use over the last 10 years due to weather and/or capacity constraints.

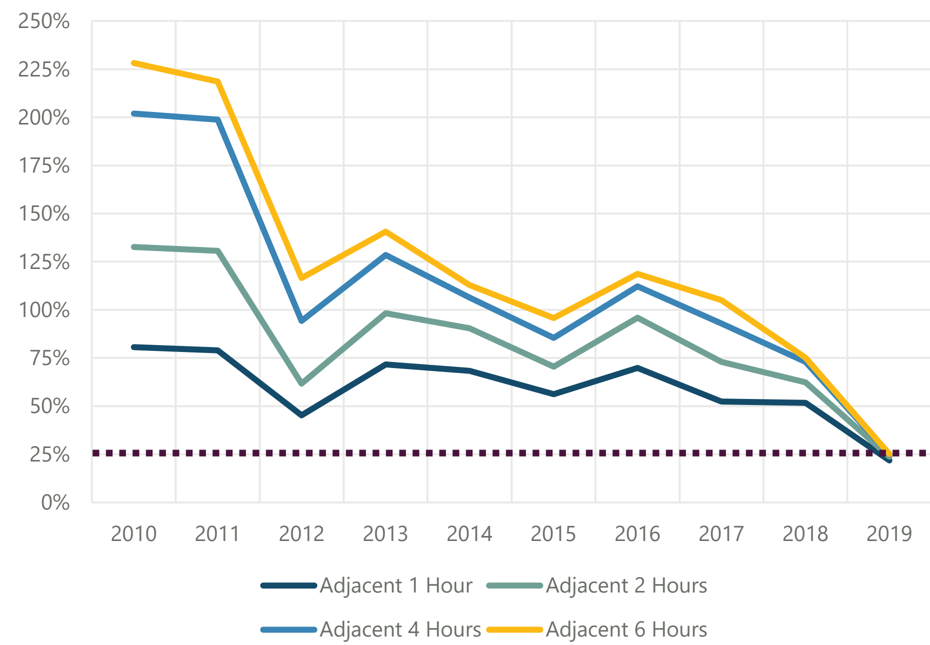
ANCA Request

- Demonstrate use of Runway 16-34 over the last 10 years, categorised by crosswind, operational, maintenance, or other.

Response Summary (4 of 5)

- **Exhibit 2** illustrates a declining trend in Runway 16-34 movements in hours adjacent to periods with actual recorded crosswind component exceeding 20 knots.
- **The lowest percentage, 25%**, occurred in 2019, correlating with the highest annual movement volume to date.
- The Dublin Airport AIP notes that Runway 16-34 use will be kept to a minimum subject to operational requirements. The declining trend indicates a focus on continuous improvement, seeking to decrease the utilisation of the runway to as close as possible to only periods when the crosswind component actually exceeds 20 knots on Runway 10-28.

Exhibit 2: Percent Possible Forecast Crosswind Above Actual Crosswind Movements



ANCA RFI No. 80

Use of Runway 16-34 from 2010-2019 by Category (5 of 5)

ANCA Request No. 80	
NOTES/DOC REF **EIAR Main Report, 2.5 Description of Operations** "For the purposes of this EIAR an assumption of use for 1% of aircraft movements was used which is based on the percentage of time it is likely to be essential for use, i.e. when the crosswind component requires its use"	**REQUEST** The Applicant is requested to provide evidence to support the assumption that the crosswind runway will be used for less than 1% of ATM's. The Applicant is requested to provide data demonstrating its use over the last 10 years due to weather and/or capacity constraints.

ANCA Request

- Demonstrate use of Runway 16-34 over the last 10 years, categorised by crosswind, operational, maintenance, or other.

Response Summary (5 of 5)

- 2019 represents the most efficient utilisation of Runway 16-34 to date for crosswind purposes with 25% additional movements on Runway 16-34 during the six hours before and after actual recorded crosswind periods. Based on this analysis it is assumed that an efficient operation would result in 25% additional movements related to crosswind during hours adjacent to periods of actual crosswind component exceeding 20 knots.
- **Table 4** illustrates the estimated crosswind related movements in each year from 2010-2019 by applying 25% additional movements to the movements that occur during actual crosswind periods.
- The average percentage of estimated crosswind movements over the 10-year period is **1.2%**.

Table 4: Runway 16-34 Movement Due to Estimated Crosswind Requirements

	Runway 16-34 Movements			
Year	Recorded Crosswind	Estimated Crosswind Related in Adjacent Hours (25%)	Total Estimated Runway 16-34 Movements Due to Crosswind	Percent Estimated Crosswind Related 16-34 Movements
2010	588	147	735	0.5%
2011	1,494	374	1,868	1.2%
2012	1,467	367	1,834	1.1%
2013	1,989	497	2,486	1.5%
2014	2,408	602	3,010	1.7%
2015	3,131	783	3,914	2.0%
2016	1,744	436	2,180	1.0%
2017	1,447	362	1,809	0.8%
2018	2,718	680	3,398	1.5%
2019	1,003	251	1,254	0.5%
Total	**17,989**	**4,497**	**22,486**	**1.2%**

ANCA RFI No. 81

Confirmation of Runway 16-34 Use Under Current Planning Permission

ANCA Request No. 81

NOTES/DOC REF	REQUEST
EIAR Main Report, 3.3 Patterns of Demand "Meeting this level of departures demand in the 06:00 hour requires use of the North Runway in the 06:00-06:59 hour."	The Applicant is requested to confirm whether the crosswind runway, under the current planning permission is used to respond to demand in the hour 0600-0700.

ANCA Request

- Confirm whether Runway 16-34 would be used to provide capacity during the 0600-0700 period under the current planning permission.

Response Summary

- Condition 4 of the current planning permission prohibits use of Runway 16-34 other than for essential safety reasons.
- Noise modeling of the Permitted Operations Situation does not include Runway 16-34 movements in the 0600-0700 period to respond to demand.

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Appendix 4A. ANCA Noise Information Reporting Template

Document Classification: Class 1 - General

An tÚdarás Inniúil um Thorann Aerárthaí
Aircraft Noise Competent Authority

Aircraft Noise Information Reporting under
The Airport Noise (Dublin Airport) Regulation Act 2019

Draft Version 2

May 2020

Draft Data Request Templates

These data request templates have been prepared by ANCA to support the 'Process of Aircraft Noise Regulation' as defined in Part 2, Section 9 of the Aircraft Noise (Dublin Airport) Regulation Act 2019 ('the Act', S.I. No. 12 of 2019) for which ANCA is the Competent Authority.

These data request templates focus specifically on information required to enable ANCA to determine the noise situation, clarify any noise problem, and begin the process of setting a Noise Abatement Objective (NAO) (if necessary) for Dublin Airport as well as facilitating the reporting of information as part of the process.

1. Preliminary Information

Preliminary information is requested to assist ANCA in understanding the potential changes to aircraft operations resulting from the application. For all development proposals, ANCA requests that information is provided to indicate whether the development would result in:

a. Additional stand capacity	If so: - How many stands and what aircraft can these accommodate? - Can information be provided in relation to the use of the stands?
b. Additional aircraft capacity / movements	If so: - What additional capacity would be generated above and beyond either the operational capacity and/or any existing restrictions on airport movements? - When would the additional capacity be used? i.e. what slots would be generated?
c. Change in Fleet Mix at the Airport	i.e. does the change result in a change in the proportion of various aircraft types operating at the airport
d. Rate of growth	i.e. does the change facilitate accelerated growth of aircraft operations? If so, growth forecasts in terms of ATMs and Passengers should be provided.
e. Change in the use of the Airport's runways	If the proposals result in a change in the use of the airport's existing runways then information regarding the proposed operating pattern should be provided alongside a baseline position.
f. Use or location of airspace	If the proposals result in a change in the use of the airport's existing airspace then information regarding the proposed operating pattern should be provided alongside a baseline position.

Responses to the above should be accompanied by data provided, where possible, using the 'Scenarios' and 'FleetMove', and 'ManagementMeasures' tabs within the data reporting template. A qualitative description of the development should be provided against each of the considerations (a – f) above to support ANCA in determine whether any aspect of the development relation to noise may arise from its operation.

2. Noise Situation and Forecasts

ANCA requires information that describes the noise situation taking into account relevant context namely existing consents and restriction. For development proposals, ANCA requires forecasts to be provided help determine whether any noise problem currently exists or would arise from the carrying out of the development as proposed.

Under the Act, ANCA has defined:

- a ‘situation’ to represent the historic, current and future noise conditions that would prevail in the absence of development or changes to the existing consents.
- a ‘forecast without new measures’ to represent the situation which would prevail as a result of development proposals but without any noise-related action. This should be representative of an unconstrained / unrestrictive operation.
- a ‘forecast including additional measures’ to represent the noise conditions that would arise from any development proposals inclusive of specific or combinations of noise mitigation measures.

ANCA urges the Applicant to provide information presenting both forecasts scenarios i.e. including and excluding measures. These measures shall include all noise mitigation and other noise-related action including within the Applicants development proposals or are in the pipeline.

At this time (April 2020), ANCA’s current view of the noise situation at Dublin Airport is set out in Table 1 below.

All situations and forecasts should be provided with a ‘Scenario ID’ and described in the ‘Scenarios’ tab of the data reporting template. The ‘Scenarios’ tab allows for high level descriptions of the scenarios to be reported including whether the scenario can be considered a ‘situation’ or ‘forecast’ based on the descriptions outlined above.

All noise management measures which form part of the scenarios should be reported within the ‘ManagementMeasures’ tab. This should be completed to provide detail either within the reporting template itself or through references to external information / documentation. These have been presented with respect to the categories of noise management as defined within the ICAO ‘Balanced Approach’ and within Annex I of Regulation (EU) No. 598/2014.

Where possible, information describing the diurnal pattern of aircraft movements should be provided for each ‘ScenarioID’ within the ‘Diurnal’ tab of the reporting template. The ‘Diurnal’ tab allows information to be presented for an annual average (i.e. over a whole year) as well as the peak summer season. The ‘Diurnal’ tab also includes the provision for reporting aircraft noise quotas by each hour of the night. Where aircraft noise quotas are reported these should be calculated using the latest aircraft quota counts as reported by NATS and the UK Civil Aviation Authority (UK CAA)[1] .

[1] Available here: https://www.aurora.nats.co.uk/htmlAIP/Publications/2019-03-31/html/eSUP/EG-eSUP-2019-012-en-GB.html

2.1 Noise Situation

ANCA consider the following scenarios presented in Table 1 to describe the noise situation with respect to the process of noise regulation under the Act.

Table 1 – Scenarios Describing the Situation at Dublin Airport

Index	Noise Situation	Description	Rationale
A	Consented Situation	A scenario which describes the impact consented at the Oral Hearing for the North Runway.	To identify the impact that was consented following the North Runway Oral Hearing. The EIS indicated this was 2025, with 310k movements, and 38M passengers with average growth. It is understood that the operating restrictions attached to the North Runway Consent were not assessed. This point was made by daa at the Meeting. This situation would therefore provide a contextual understanding of the noise impact associated with the consent based on the information submitted to the Oral Hearing.
B	Current Situation	The situation in 2018/19	To understand the noise impact of the Airport at this moment in time with the airport operating in its current form and with the passenger capacity restrictions in place.
C	Pre-North Runway Operation	The situation in 2021/2 immediately before the opening and operation of the new North Runway	To understand how the noise impact of the Airport will change from now and to before the North Runway comes into operation with the passenger capacity restrictions in place.
D	Current Consented North Runway Operation upon Opening	The situation immediately after the opening and operation and the North Runway	To understand what would happen in the year following the opening of the North Runway with the Airport operating in line with its current consents, including the passenger capacity restriction.
E	Future Forecast North Runway Operation	A situation in the future following the growth of airport operations as forecast by the Airport's masterplan.	This situation provides an understanding of the noise impact associated with a mature operation taking into account the current consents, including the passenger capacity restriction.

2.2 Forecasts

ANCA strongly advises the Applicant to provide forecasts of its development proposals with and without new measures.

It should be noted that under the Act all measures available are to be identified, including operating restrictions, and the likely cost-effectiveness of the identified measured is to be thoroughly evaluated, including environmental sustainability and any interdependencies between noise and emissions as per Annex II of Regulation 598/2014.

3. Noise Exposure and Effects Information to be Provided for Current Situations and Forecasts

For each situation and forecast scenario, the following information is requested for aircraft noise resulting from take-offs and landings. This information should be reported within the 'Area', 'Dwellings', 'People' and 'Health' tabs by 'Scenario'.

For the reporting of 'Dwellings' and 'People', existing dwellings and populations should be reported alongside estimates for future dwellings and populations reported against the fields prefixed 'Fut'. These should include all forecast population growth and consented developments which are likely to affect future forecast noise exposure. The future reporting elements are split into three sub-classes, of "FutOcc", "FutCon", and "FutZon", for newly Occupied dwellings, Consented developments and Zoned lands respectively. This is considered appropriate as the first represents completed and occupied dwellings since the baseline situation, the second represents post consent developments which may be expected to proceed, and the third represents pre-consented areas around the airport which would need to be addressed in light of the local land use management and planning policy in place at the relevant time of an application.

3.1 Noise Exposure Information

- Strategic noise maps for the following noise indicators and noise levels:
    - L_{den} for 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, ≥ 75 dB
    - L_{night} for 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, ≥ 70 dB
    - $L_{Aeq,16hr}$ for 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, ≥ 75 dB

  NOTEs: 1) L_{den} and L_{night} are annual average, $L_{Aeq,16hr}$ is average 92-day summer day
  2) All results are to be delivered as both grid points and noise level contour polygons
  3) All results are to be delivered as maps in PDF format

- Assessment of noise exposure, in 1 dB bands, due to airport operations in terms of:
    - Area (km²);
    - Number of dwellings;
        - Including dwellings with insulation against noise i.e. those with insulation already in place;
        - Including dwellings within voluntary residential purchase scheme;
        - Including dwellings within voluntary residential noise insulation scheme;
    - Number of people living in dwellings;
        - Including people living in dwellings with insulation against noise i.e. those with insulation already in place;
        - Including people living in dwellings within voluntary residential purchase scheme;
        - Including people living in dwellings within voluntary residential noise insulation scheme;
    - Number of non-residential noise-sensitive receptors;
        - Including, as a minimum, the number of schools and hospitals;
        - Including schools within the voluntary school insulation scheme.

  NOTE: When considering any forecasts, areas of land zoned for future residential use should be included within the assessment, in addition to any approved and/or under construction residential developments must be accounted for within the analysis.

- Noise level difference maps comparing the existing situation with each potential future scenario in 1 dB noise level change bands:
    - L_{den};
    - L_{night};
    - $L_{Aeq,16hr}$;
    - Area (km²);

- Number of dwellings;
  - Including dwellings with insulation against noise i.e. dwellings with approved scheme insulation already in place;
  - Including dwellings within voluntary residential purchase scheme;
  - Including dwellings within voluntary residential noise insulation scheme;
- Number of people living in dwellings;
  - Including people living in dwellings with insulation against noise i.e. those with approved scheme insulation already in place;
  - Including people living in dwellings within voluntary residential purchase scheme;
  - Including people living in dwellings within voluntary residential noise insulation scheme;
- Number of non-residential noise-sensitive receptors;
  - Including, as a minimum, the number of schools and hospitals;
  - Including schools within the voluntary school insulation scheme.

  NOTE: When considering any forecasts, areas of land zoned for future residential use should be included within the assessment, in addition to any approved and/or under construction residential developments must be accounted for within the analysis.

daa are invited to provide further, objective measures, using the following or derivations of, for example:

- L_{day};
- $L_{evening}$;
- L_{Amax}; and
- SEL

Noise exposure data should be provided in a digital format. All noise contours and noise level grids should be provided in a GIS format within the WGS84 or ETRS89 projection systems.

3.2 Noise Effects Data

Using the noise exposure data, the effects information should be provided:

- Assessment of any significant effects of noise on sensitive receptors;
- Assessment of harmful effects due to long term exposure to noise from airport operations, including:
  - Number of people living in dwellings highly annoyed;
  - Number of people living in dwellings highly sleep disturbed;
  - Sub-totals per Electoral Division
    - Where effects are to be reported per Electoral Division, this should be achieved by prefixing the elements presented in the 'Health' tab to report designators for the Electoral Divisions.
- Assessment of costs of noise exposure, including:
  - Costs of annoyance;
  - Costs of health.

When considering any forecasts, areas of land zoned for future residential use should be included within the assessment, in addition to any approved and/or under construction residential developments must be accounted for within the analysis. These future reporting elements are split into three sub-classes, of "FutOcc", "FutCon", and "FutZon", for newly Occupied dwellings, Consented developments and Zoned lands respectively. The costs of noise exposure on health should ideally be monetised.

The Applicant is advised, as a minimum, to have regard for the relevant guidance documents when preparing noise effects data.

- WHO Community Noise Guidelines 1999 – WHO CNG 1999;
- WHO Night Noise Guidelines 2009 – WHO NNG 2009;

- WHO Environmental Noise Guidelines 2018 – WHO ENG 2018;
- EEA Good practice guide on noise exposure and potential health effects, Technical report No 11/2010 – EEA 2010
- CAA CAP1506: Survey of noise attitudes 2014: Aircraft - SONA 2014
- EPA Guidance Note for Strategic Noise Mapping, Version 2, August 2011;
- EPA Guidance Note for Strategic Noise Mapping, Revised Section 10: Methodology for Exposure Assessment – Post Processing and Analysis, October 2017;
- EPA Guidelines on the Information to be Contained in Environmental Impact Assessment Reports, Draft, August 2017;
- Appropriate Assessment of Plans & Projects – Guidance for Planning Authorities (2009) DoEHLG.

4. Data to be Reported

A summary of data to be reported by Dublin Airport Authority is set out in Table 2.

Table 2: Information to be reported by daa

ID	Title	Contents / Minimum Requirements
1	Noise Levels ESRI Shapefiles Points	Air noise level results in ESRI Shapefile Point format
2	Noise Levels ESRI Shapefile Polygons	Air noise level results in ESRI Shapefile Polygon format
3	Noise Levels PDF Maps	Air noise level results presented as PDF format graphical maps
4	Exposure Statistics	Air noise area, dwelling & people exposure statistics spreadsheet
5	Noise Modelling Report	See Section 4.5 for minimum requirements
6	Population and Demographic Methodology Report	See Section 4.6 for requirements
7	Exposure and Effects Methodology Report	See Section 4.7 for requirements
8	Noise Mitigation Feasibility Report	See Section 4.8 for requirements
9	Metadata	Metadata files providing information on each of the reports

Set out below is detailed requirements for each of the reports to be read in conjunction with accompanying template files, where relevant.

4.1 Noise Level ESRI Shapefiles Points

Based upon the results of the noise level calculations the results are to be delivered as 10m Grid points in ESRI Shapefile Point format in WGS84 or ETRS89 projection.

The Shapefile format was developed by ESRI and although it is a proprietary format, it has open documentation and has become a de facto standard supported by all the leading commercial noise mapping software systems, and most commercial and open source GIS software packages.

What is referred to as a “Shapefile" is actually a set of several files. Four individual files are mandatory to store the core data that comprises a Shapefile ("<a>.shp", "<a>.prj", "<a>.dbf" and “<a>.shx”; <a> being the file name, which should be the same for all the files). If only the single “.shp” file is provided this file cannot be used for any purpose, as it is incomplete for distribution. The other three supporting files are required.

Shapefiles can either contain point, polyline or polygon data, however only one type of data may be stored within a single Shapefile. The noise level grid points can be exported to Shapefile Point files, noise contour lines can be exported to Shapefile Polyline format, and noise contour bands can be exported to Shapefile Polygon format files.

The Shapefiles of noise level grid results to be provided are shown in Table 3. The noise level results grids should be exported without any processing of the noise levels, such that the calculated noise levels for each grid point are exported as is. Noise calculations should be undertaken on a grid resolution of 50m x 50m or at a more refined resolution.

Each Shapefile should be accompanied by the corresponding metadata. More information on metadata for spatial files is detailed in Section 4.9 below.

Should any other noise indictors and metrics be provided then the same format should be applied.

Table 3: Minimum of 50m noise level grids for each scenario

Scenario	Indicator	Name of the ESRI Shapefile Point file
*[ScenarioID]_[Scenario]_[Year]*_Grid	L_{den}	*[ScenarioID}_[Scenario]_[Year]*_Grid_Lden_*[Version]*
	L_{night}	*[ScenarioID}_[Scenario]_[Year]*_Grid_Lngt_*[Version]*
	$L_{Aeq,16hr}$	*[ScenarioID}_[Scenario]_[Year]*_Grid_LA16_*[Version]*
	L_{day}	*[ScenarioID}_[Scenario]_[Year]*_Grid_Lday_*[Version]*
	$L_{evening}$	*[ScenarioID}_[Scenario]_[Year]*_Grid_Leve_*[Version]*
	L_{Amax}	*[ScenarioID}_[Scenario]_[Year]*_Grid_Lmax_*[Version]*
	L_{SEL}	*[ScenarioID}_[Scenario]_[Year]*_Grid_LSEL_*[Version]*

NOTE: In line with Annex I of Directive 2002/49/EC daa are invited to provide results for the supplementary indicators L_{day}, $L_{evening}$, L_{Amax} and SEL

Table 4: Attribute table for ESRI Shapefile Point files

ScenarioID (SCENARIOID)	Integer (4)
Scenario (SCENARIO)	Text (10)
Year (YEAR)	Integer (4)
Indicator (IND)	Text (10)
Level (DB)	Float (6, 2)

4.2 Noise Level ESRI Shapefiles Points

Based upon the results of the noise level calculation grids the noise mapping software is able to run an interpolation process to generate noise level contours, which may be presented in 1 dB(A) wide noise level bands described by polygon objects. These results are to be delivered as polygon objects in ESRI Shapefile Polygon format in WGS84 projection.

The noise contour polygons should be exported for the following noise indicators and noise level bands:

- L_{den} for 45 to ≥ 75 dB
- L_{night} for 40 to ≥ 70 dB
- $L_{Aeq, 16hr}$ for 45 to ≥ 75 dB
- L_{day} for 45 to ≥ 75 dB
- $L_{evening}$ for 45 to ≥ 70 dB

Delivery of 1 dB contour polygons will enable maps to be drawn up at 1 dB, 3 dB or 5 dB intervals as may be appropriate for various different views on the data.

The Shapefiles of noise contour bands to be provided are shown in Table 5.

Each Shapefile file should be accompanied by the corresponding metadata. More information on metadata for spatial files is detailed in Section 4.9 below.

Should any other noise indictors and metrics be provided then the same format should be applied.

Table 5: Noise contour bands for each scenario

Noise source	Indicator	Name of the ESRI Shapefile Polygon file
*[ScenarioID]_[Scenario]_[Year]*_Polygon	L_{den}	*[ScenarioID]_[Scenario]_[Year]*_Polygon_Lden_*[Version]*
	L_{night}	*[ScenarioID]_ [Scenario]_[Year]*_Polygon_Lngt_*[Version]*
	$L_{Aeq,16hr}$	*[ScenarioID]_ [Scenario]_[Year]*_Polygon_LA16_*[Version]*
	L_{day}	*[ScenarioID]_ [Scenario]_[Year]*_Polygon_Lday_*[Version]*
	$L_{evening}$	*[ScenarioID]_ [Scenario]_[Year]*_Polygon_Leve_*[Version]*

NOTE: In line with Annex I of Directive 2002/49/EC daa are invited to provide results for the supplementary indicators L_{day}, $L_{evening}$

Table 6: Attribute table for ESRI Shapefile Polygon files

ScenarioID (SCENARIOID)	Integer (4)
Scenario (SCENARIO)	Text (10)
Year (YEAR)	Integer (4)
Indicator (IND)	Text (10)
Level (DB)	Integer (3)

4.3 Noise Level Maps in PDF Format

Based upon the results of the noise level calculation the noise contour polygons are to be presented at 5 dB intervals in maps delivered in PDF format. The PDF maps to be submitted may be prepared such that the whole of the noise contour footprint from DIA is shown on a single A3 page. The noise level contours should be overlaid above OS mapping data, and should include information on the location and names of villages and towns within the maps.

Maps should be prepared for the following noise indicators and noise level bands:

- L_{den} for 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, ≥ 75 dB
- L_{night} for 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, ≥ 70 dB
- $L_{Aeq,\ 16hr}$ for 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, ≥ 75 dB

In line with Annex I of Directive 2002/49/EC daa are invited to provide results for the supplementary indicators L_{day}, $L_{evening}$.

- L_{day} for 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, ≥ 75 dB
- $L_{evening}$ for 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, ≥ 75 dB

The colour bands below are recommended for use in the production of noise level contour maps are presented in Table 8 below. The colour bands are based upon those developed by Dr Beate Weninger and presented at coloringnoise.com. Furthermore, it is recommended that the colour bands are made semi-transparent such that the base mapping below remains partly visible such that orientation and location remains possible.

The PDF maps of noise contour bands to be provided are shown in Table 6.

Should any other noise indictors and metrics be provided then the same format should be applied.

Table 7: Noise contour band PDF map sets for DAA

Noise source	Indicator	Name of the PDF maps
*[ScenarioID]_[Scenario]_[Year]_*Map	L_{den}	*[ScenarioID]_[Scenario]_[Year]_*Map_Lden_*[Version]*
	L_{night}	*[ScenarioID]_ [Scenario]_[Year]_*Map_Lngt_*[Version]*
	$L_{Aeq,16hr}$	*[ScenarioID]_ [Scenario]_[Year]_*Map_LA16_*[Version]*
	L_{day}	*[ScenarioID]_ [Scenario]_[Year]_*Map_Lday_*[Version]*
	$L_{evening}$	*[ScenarioID]_ [Scenario]_[Year]_*Map_Leve_*[Version]*

Notes: It is recommended that class boundaries be at .00, e.g. 55 to 59 is actually 55.00 to 59.99.

Table 8: Recommended Noise Level Bands for PDF Maps

Noise zone dB	Colour	Code	Red	Green	Blue
< 40	Transparent				
40 to 44	Light blue-green	# B8 D6 D1	184	214	209
45 to 49	Light green	# CE E4 CC	206	228	204
50 to 54	Yellowish green	# E2 F2 BF	226	242	191
55 to 59	Light orange	# F3 C6 83	243	198	131
60 to 64	Orange	# E8 7E 4D	232	126	77
65 to 69	Dark orange	# CD 46 3E	205	70	62
70 to 74	Magenta	# A1 1A 4D	161	26	77
≥75	Purple	# 75 08 5C	117	8	92

NOTE: Colour scheme from colouringnoise.com used under Creative Commons License

4.4 Exposure Statistics

The exposure assessment is to determine the exposure to L_{den}, L_{night} and $L_{Aeq,16hr}$ noise levels within 5dB bands of the following:

- Area (km^2);
- Dwellings, and where possible whether the dwellings are occupied or not;
- Numbers of people living within dwellings, for occupied dwellings.

In line with Annex I of Directive 2002/49/EC daa are invited to provide results for the supplementary indicators L_{day}, $L_{evening}$.

The recommended methodology for determining the exposure is set out within the October 2017 update to the EPA Guidance Note on Strategic Noise Mapping, namely "Revised Section 10 of Guidance (Oct 17).pdf".

For each of the exposure assessments to be undertaken a reporting template is provided.

Exposure statistics should be prepared for the following noise indicators and noise level bands:

- L_{den} for 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, ≥ 75 dB
- L_{night} for 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, ≥ 70 dB
- $L_{Aeq,16hr}$ for 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, ≥ 75 dB

In line with Annex I of Directive 2002/49/EC daa are invited to provide results for the supplementary indicators L_{day}, $L_{evening}$:

- L_{day} for 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, ≥ 75 dB
- $L_{evening}$ for 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, ≥ 75 dB

In order to assess the potential long-term health effects, ANCA request that for each operational scenario the following information is provided:

- WHO 2018, Dir 2020/367 - %HA - L_{den} for 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, ≥ 75 dB
- WHO 2018, Dir 2020/367 - %HSD - L_{night} for 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, ≥ 70 dB
- EEA 2010 - %HA - L_{den} for 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, ≥ 75 dB
- EEA 2010 - %HSD - L_{night} for 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, ≥ 70 dB
- SONA 2014 - %HA - L_{den} for 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, ≥ 75 dB

In order to contextualise the exposure data, ANCA request that for each operational scenario the following information is also provided:

- Annual average aircraft movements, by day, evening and night periods;
- Average summer day aircraft movements, by 16hr day and 8 hr night periods.

For each of the scenarios and movement periods, ANCA request that the fleet movement data per aircraft type is provided by day, evening and night periods for both the annual average and average summer day periods.

For each of the scenarios and movement periods, ANCA request that the fleet movement data per hour is provided by day, evening and night periods for both the annual average and average summer day periods.

4.5 Noise Modelling Report

All information should be accompanied by a modelling report describing the approach and supporting evidence for modelling works, including:

- Confirmation of the noise assessment method i.e. ECAC Doc 29 4th Edition including the modelling software utilised
- Confirmation of input datasets including:
  - Schedules / Flight Records including copies of relevant flight operations reports
  - Meteorological conditions
  - Inputs to flight track assumptions including dispersions
  - Inputs to flight profile and aircraft type assumptions
  - Modal Splits
- Validation Methodologies and Adjustments
  - Reporting of any validation activities including the preparation and evidencing of:
    - Customised procedures profiles; and/or
    - NPD adjustments based on noise monitoring data
- Calculation Settings, including:
  - Grid resolutions / dynamic grid settings
  - Receptor definitions
  - Application of meteorology
  - Use of bank angle
  - Ground attenuation

4.6 Population and Demographic Methodology Report

A methodology report is required to demonstrate how the following has been considered in the reporting of noise exposure and effects:

- Consideration of zoned lands;
- Residential developments that are approved and/or under construction;
- Analysis and monitoring of population encroachment around the Airport;
- Use and application of any population and/or demographic datasets including those describing non-residential noise-sensitive receptors;
- Approach to and datasets used for forecast population approved and/or under construction residential developments;

4.7 Exposure and Effects Methodology Report

The applicant shall report its methodology for the calculation of noise exposure and effects using noise model outputs and relevant demographic datasets. In this respect, it is recommended that ANCA advise that the applicant shall have regard to for the approaches defined within EC Directive 2002/49/EC, Commission Directive (EU) 2015/996 establishing common noise assessment methods according to Directive 2002/49/EC, and Commission Directive (EU) 2020/367 amending Annex III on assessment methods for harmful effects of environmental noise.

4.8 Noise Mitigation Feasibility Report

Where noise mitigation is explored in any of the forecasts provided, ANCA require a report to identify the feasibility of such measures in the context of the potential cost, safety and practicality implications for Dublin Airport. These measures include, but are not limited to:

- Reduction of noise at source
  - Financial incentives such as:
    - Landing charges
    - Taxes
  - Displaced Landing Thresholds
- Noise Abatement Operating Procedures
  - Steeper / Segmented Approach Procedures
  - Continuous Climb Operations
  - Runway Alternation
  - Preferential Runway Use
  - Directional Preference
  - Noise Abatement Departure Procedures
  - Airspace Design / Navigational Aids
- Land Use Management
  - Land Use Planning
  - Noise Insulation Schemes
  - Relocation Schemes

It is recommended that ANCA consider the potential cost, safety and practicality issues associated with any noise mitigation being explored.

4.9 Metadata

The reporting from daa to ANCA is based upon electronic files. Therefore, in order to manage these files effective metadata needs to be provided with each item reported.

The specified metadata standards for spatial data are those currently adopted by ANCA and proposed for future use within INSPIRE. They are based around a profile of ISO19115.

The standard for non-spatial data has been based upon the widely used Dublin Core metadata standard.

In order to be able to deal with the data provided, it is very important to provide some information about the data itself.

Therefore, several metadata files are to be provided to accompany the information reported. Template files for the metadata are provided for each dataset to be reported.

The metadata within the template files consists of the elements in Table 9.

Each metadata .xml file should be named to match the accompanying dataset.

Table 9: Guidance on metadata requirements

	Description
File Identifier	Unique file name, should match accompanying dataset
Language	ISO 639-2 Language Code
Character Set	ISO TC 211 Character Code
Hierarchy Level	ISO 19139 Scope Code
Organisation Name	Organisation name responsible for metadata
Contact Info	Email address
Role	ISO 19139 Role Code
Date	Date of metadata creation or revision
Metadata Standard Name	ISO 19115
Metadata Standard Version	2003 Cor. 1 2006
Reference System Info	CRS of harmonised dataset
Identification Info	Dataset identification
Citation	Dataset citation
Dataset Title	Human readable name of the dataset
Dataset Date	Date when dataset was revised
Dataset Set	ISO19139 Data Type Code
Dataset Creation Date	Date when dataset was created
Identifier	Same name as the title, but with underscores
Code Space	Daa website
Abstract	Information on the dataset; what it is depicting, what it is about.
Organisation Name	The organisation responsible for the data
Contact Info	Email address
Role	ISO 19139 Role Code
Keyword	Name and link of the INSPIRE data theme which the dataset falls under
Thesaurus Name	Name of thesaurus used
Date	Date of publication of the thesaurus
Date Type	ISO 19139 Date Type Code
Use Limitations	If there are conditions on the use of data
Access Constraints	ISO 19139 Restrictions Code
Other Constraints	If there are no limitations on the data
Topic Category	Environment
Extents	N, E, S, W bound lat/long decimal coordinates of bounding box
Data Quality	ISO 19139 Scope Code
Data Quality Title	INSPIRE Directive
Explanation	Any reference specification
Lineage	Include information on the history of the dataset, overall quality of the data, how the data was collected, any QA checks

Appendix 6A. Impacts on Existing Land Use and Zoning

Document Classification: Class 1 - General

Appendix 6A. Existing Land Use and Zoning

Introduction

In order to assess the potential for impacts from the proposed Relevant Action on existing land use and land use zoning it was first required to determine the appropriate study area i.e. lands surrounding Dublin Airport. As the potential for noise impacts from operations at Dublin Airport is already a measurable value used for assessment of impacts on land use within the County Development Plan, it was considered that the potential noise impacts of the proposed Relevant Action on existing land use and land use zoning within the airports surrounds should be clarified and assessed to determine the nature of impact if any. It is noted that Chapter 11 of this EIAR identifies and appropriately assesses the likely significant effects on greenhouse gas (GHG) emissions as a result of the proposed Relevant Action and therefore this chapter does not purport to review or detail the impacts of GHG as a result of the proposal.

For the purpose of this assessment the land uses and land zoning within the 40dB Lnight noise contour (Refer Plate 6-1) is considered to form the appropriate study area. The use of the 40dB noise contour is supported by the *'Dublin Agglomeration Environmental Noise Action Plan December 2018 – July 2023'* which states *'An Lnight value of 40dB is the limit suggested by the World Health Organisation to avoid negative health effects on humans'*. Furthermore, it is noted that the 40dB Lnight contour is also used to define the outer zone (Zone D) in the Variation No.1 to the Fingal County Development Plan, which makes it a suitable point for the study area.

The land use zoning within the study area is set out in detail below. The key objective of the assessment of potential impacts is to understand if the proposed Relevant Action has any significant impact on the existing planning policy which relates to the surrounding land use zones, including the ability of the relevant policy objectives to be achieved.

Surrounding Land Use Zones

In order to determine if the proposed Relevant Action will have any impact on existing land use zoning surrounding the airport or the ability of the relevant policy objectives set out within the Development Plan to be achieved, the land use zoning surrounding the airport must be identified. In this regard, it is noted that the land use zoning surrounding the airport and wider area includes a mix of land use zones and zoning objectives. Whilst each land use zone may accommodate a range of land uses, some zones prohibit sensitive uses[1], being residential, hospitals, residential care facilities and schools.

The following land use zones do not permit these above-mentioned sensitive uses and are therefore considered to be less sensitive to impact from the proposed Relevant Action.

Table 1 Land Use Zones which Prohibit Sensitive Land Uses

Fingal County Council Zoning

DA – Dublin Airport	HI – Heavy Industry	WD – Warehousing & Distribution
FP – Food Park	RB – Rural Business	GE – General Employment
OS – Open space	RW – Retail Warehousing	
Meath County Council Zoning		
D1 - Tourism	E2 – General Enterprise & Employment	F1 – Open Space
B2 - Retail Warehouse Park		
Kildare County Council Zoning		
F – Open Space and Amenity	H – Industrial and Warehousing	
Q – Enterprise & Employment	U – Transport and Utilities	

[1] These sensitive uses are set out within Variation No. 1 to the County Development Plan

Dublin City Council Zoning		
Z7 – Employment (Heavy)	Z9 – Amenity/Open Space Lands/Green Network	Z11 – Waterways Protection
South Dublin County Council Zoning		
EE – enterprise and Employment	RW – Retail Warehousing	

It is noted that as the study area covers a substantial portion of FCC area and parts of the local government areas associated with Meath County Council, Dublin City Council and South Dublin County Council, there is a range of land use zonings and zoning objectives within the study area. These include the following:

Table 2 Main Land Use Zoning Objectives Surrounding Dublin Airport

Zone	Zoning Objective
CI – Community Infrastructure	*Provide for and protect civic, religious, community, education, health care and social infrastructure*
FP – Food Park	*Provide for and facilitate the development of a Food Industry Park*
GB – Green	*Protect and provide for Greenbelt*
GE – General Employment	*To provide opportunities for general enterprise and employment'.*
HA – High Amenity	*Protect and enhance high amenity areas*
HI – Heavy Industry	*Provide for Heavy Industry*
HT – High Technology	*Provide for office, research and development and high technology/high technology manufacturing type employment in a high quality built environment*
LC – Local Centre	*Protect, provide for and/or improve local centre facilities*
MC – Major Town Centre	*Protect, provide for and/or improve local centre facilities*
ME – Major Economic Corridor	*Facilitate opportunities for high density mixed use employment generating activity and commercial development, and support the provision of residential development within the Metro Economic Corridor*
OS – Open Space	*Preserve and provide for open space and recreational amenities*
RA – Residential Area	*Provide for new residential communities subject to the provision of the necessary social and physical infrastructure*
RB – Rural Business	*Provide for and facilitate rural-related business which has a demonstrated need for rural location*
RC – Rural Cluster	*Provide for small scale infill development serving local needs while maintaining the rural nature of the cluster*
RS – Residential	*Provide for residential development and protect and improve residential amenity*
RU – Rural	*Protect and promote in a balanced way, the development of agriculture and rural-related enterprise, biodiversity, the rural landscape, and the built and cultural heritage*

Zone	Zoning Objective
RV – Rural Village	*Protect and promote the character of the Rural Village and promote a vibrant community in accordance with an approved Local Area Plan, and the availability of physical and community infrastructure*
RW - Retail Warehousing	*Provide for retail warehousing development*
TC – Town and District Centre	*Protect and enhance the special physical and social character of town and district centres and provide and/or improve urban facilities*
WD – Warehouse and Distribution	*Provide for distribution, warehouse, storage and logistics facilities which require good access to a major road network within a good quality environment*

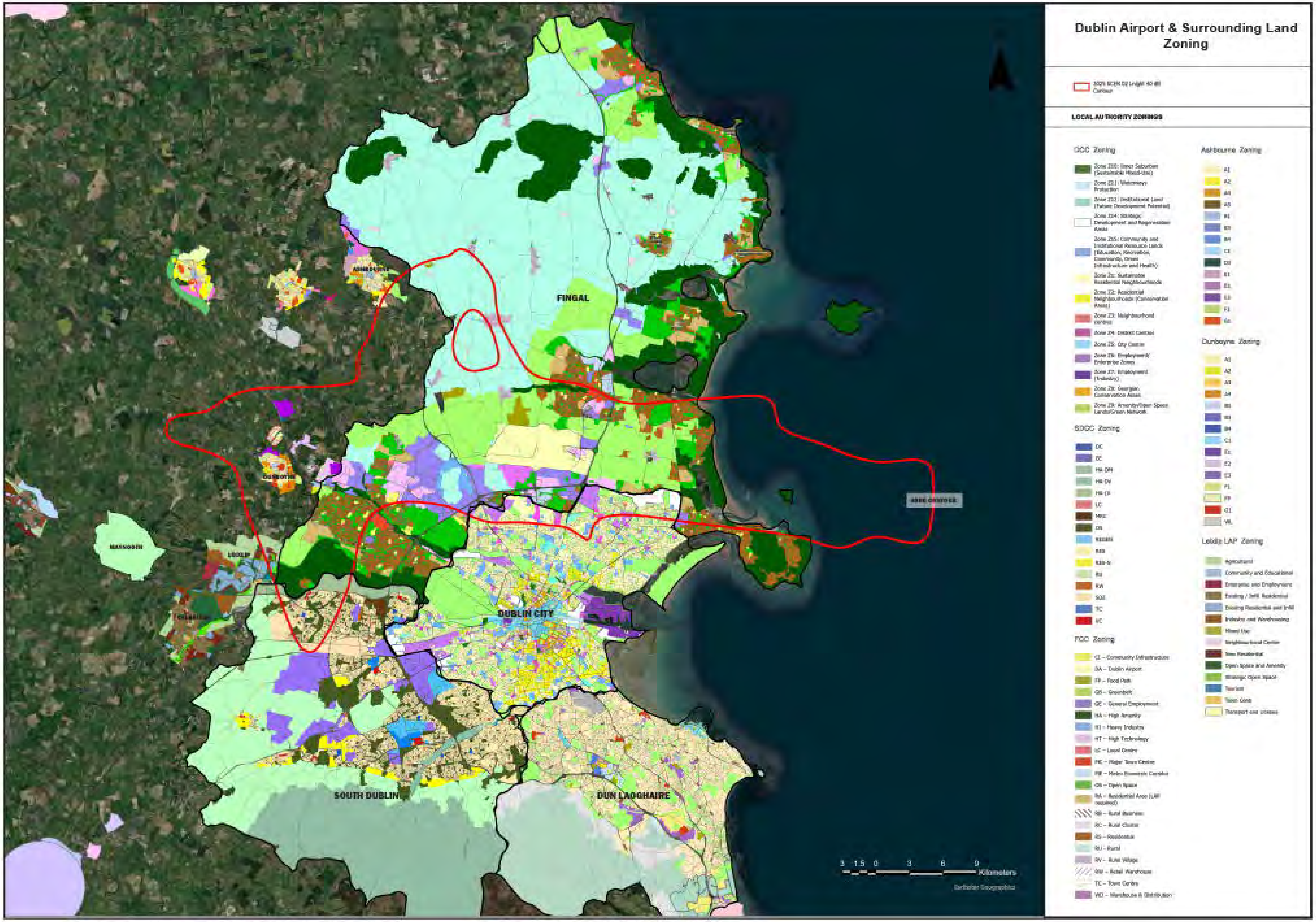


Plate Error! No text of specified style in document.**-1 Extract of Zoning Map from County Development Plan, Variation No:1 and edited by TPA to include 40dB contour**

On a macro-scale it is apparent that the land to the east and west of the airport is predominately zoned Green Belt. This Green Belt land use zoning protects the encroachment of inappropriate and incompatible land uses within close proximity to the airport as only certain small scale sensitive uses are permitted in principle within this zone, highlighting the importance of ensuring inappropriate land uses do not encroach or impact on this piece of national infrastructure. The surrounding land use zonings are discussed in more detail below.

Land to the North

Directly to the north of the airport and Dublin Airport zoned lands is predominately Green Belt land. The predominant land use is agriculture. The greenbelt lands are interspersed with Open Space lands associated with Forrest Little Golf Club, and Food Park zoned lands known as Roslin Food Park. There is also some General Employment land within this area known as Metropoint Business Park.

Further to the north, is the southern part of Swords which includes a mix of largely Residential, Residential Amenity, Open Space and some Local Centre zoned land. There is also a large area of High Technology, General Employment and Retail Warehousing zoned land on eastern side of Swords; this area is more commonly known as Airside Retail & Business Park. There is also some Community Infrastructure zoned land and the southern edge of Major Town Centre zoned land which forms part of the core Swords town centre area.

The areas to the north of the airport as discussed above are largely developed or under development with the exception of some Residential zoned land to the south of Boroimhe, Residential Amenity zoned land to the west of Airside Retail and Business Park, the High Technology and Retail Warehousing zoned land in proximity to Airside Business and Retail Park. There are also examples of residential settings within surrounding Green Belt zoned land.

Land to the East

Directly to the east of the airport lands there is a portion of General Employment zoned land between the R132 and M1, beyond this land is mostly Green Belt zoning with some Residential zoned land, Open Space land located along Baskin Lane, and some Rural Village zoned land located in Kinsealy. There is also a portion of Rural Cluster zoned land within Feltrim, Portmarnock. The southern parts of Malahide include predominantly Residential zoned land, Residential Amenity zoned land and larger tracts of Open Space zoned land. Land zonings in Portmarnock also include a mix of Town Centre zoned land, Community Infrastructure zoned land and a substantial area of High Amenity zoned land associated with Portmarnock Beach, two golf courses, areas surrounding Baldoyle Bay and Ireland's Eye. Areas to the east also include High Technology, Residential, Residential Amenity and Open Space zoned land in the Belmayne/Balgriffin area.

Lands to the east are largely developed as per their underlying zoning or under development with the exception of some Residential Amenity and Residential zoned land which either benefit from existing planning permission or yet to be developed. There are also examples of residential settings within surrounding Green Belt zoned land.

Land to the South

Directly to the south of the airport, the land use zoning in and around Collinstown, Ballymun and Santry includes a mix of General Employment, High Technology, Open Space, Local Centre, Retail Warehousing and Residential zoned land. There is also a portion of Warehouse & Distribution zoned land. There is also a substantial area of Metro Economic Corridor zoned land within Ballymun.

The majority of Residential zoned land to the south has been developed or is under development in accordance with the under lying land use zoning. Large areas of General Employment, High Technology and Metro Economic Corridor zoned land directly to the south of the airport has only been partially developed at this time.

Land to the West

Directly to the west of the airport there is a portion of Rural land zoning, associated with St. Margaret's. Beyond this the land is generally zoned Green Belt with some inclusions of Warehouse & Distribution zoned land. Further to the east there is a large area of Heavy Industry zoned land associated with land uses such as Roadstone Huntstown and Huntsown Power Station. To the north-west and in around Coolquay there are areas of Rural, Food Park and Rural Village zoned lands. To the south-west and in proximity to Corduff and Mulhuddart land use zonings primarily consist of General Employment, Community Infrastructure, Residential, Residential Amenity, Open Space, Local Centre and High Amenity zoned land. The majority of this land is developed in accordance with its underlying land use zoning, with the exception of some Residential Amenity land which is either being currently developed for residential purposes or undeveloped. Further to the south-west, areas within parts of South Dublin County Council Local Government Area includes land zoned for Agriculture, Residential, Industrial, Neighbourhood Centres.

To the west and beyond the Fingal County Council boundary is land within the functional area of Meath County Council and predominantly consists of un-zoned land with the exception of land within the Dunboyne area which includes a mix of land zoned for land uses such as Offices, Business/Technology Park, General Industry, Residential, Community Services/Facilities, Neighbourhood Centre and Strategic Reserve Land.

Impact on Noise Zones

The assessment of impacts on existing land use and land use zoning required two discrete elements; the assessment of any impacts on the Noise Zones, identified in the County Development Plan, and the assessment of the impacts of the Permitted and Proposed scenarios. The assessment on these two elements was carried out for each assessment year (2022, 2025 & 2035).

As noted above, the noise zones have been developed by FCC with the overarching objective to balance the potential impact of aircraft noise on both external and internal noise amenity. The Noise Zones outline a predicted level of noise exposure for land within each of the zones and require new sensitive development to provide appropriate noise mitigation dependent on location and noise environment.

It should be noted that the noise zones are not designed to be applied independently of each other, for example Noise Zone A, has the highest potential for noise exposure during both the day (LAeq, 16hr) and night (L_{night}), whereas Noise Zone B has a lower potential for noise exposure during the day than Zone A, but has the same potential for noise exposure as Noise Zone A at night, being at least 55 dB. Therefore, a land use within Zone B may be within the 55dB Lnight contour (which applies to Noise Zone A & B) but also within the 54dB LAeq 16hr contour (which applies to Zone B and not Zone A), this land use would therefore remain within the Noise Zone B.

The key objective of this assessment was to understand if the proposed Relevant Action has any significant impact on the existing Noise Zones. i.e. as a result of the proposed Relevant Action would land uses that were previously located within Noise Zone B no longer fit the Noise Zone B criteria and be more appropriately located within Noise Zone A, therefore impacting on the policy objectives of the existing noise zones.

In this regard, the 63dB LAeq 16h, 55dB Lnight, 54dB LAeq 16h and 48dB Lnight noise contours for the permitted and proposed scenarios for the assessment years of 2022, 2025 and 2035 were overlaid onto the existing Noise Zones map from the County Development Plan. These noise contours were used as they equate to the criteria associated with each of the Noise Zones. This was completed for each of Noise Zone A, B and C[2]. The relevant figures are appended with a summary of the impacts outlined below:

Table Error! No text of specified style in document.**-3 Results of Relevant Action Impacts on FCC Noise Zones**

	Noise Zone A	Noise Zone B	Noise Zone C
Permitted Scenario 2022	Areas affected by both the predicted 63dB LAeq.16h contour and the 55dB Lnight contour are largely contained within Zone A, except for minor encroachment to the north over Food Park and Green Belt Zoned Lands. Given sensitive land uses are not permitted within these zoned lands and the area affected is limited, this encroachment is considered to be of limited significance, moreover it occurs in the existing permitted scenario.	Areas affected by both the predicted 54dB LAeq.16h contour and the 55dB Lnight contour are wholly contained within Zone B and therefore and therefore the impact to the Zone B contour is neutral	Areas affected by both the predicted 54dB LAeq.16h contour and the 48dB Lnight contour are wholly contained within Zone C contour and therefore the impact to the Zone C contour is neutral

[2] The FCC Development Plan does not map Noise Zone D and therefore land outside Zone C is potentially located in Zone D

Proposed Scenario 2022	Areas affected by both the predicted 63dB LAeq.16h contour and the 55dB L_{night} contour are entirely contained within Zone A. It is noted that this is an improvement on the Permitted Scenario.	Areas affected by both the predicted 54dB LAeq.16h contour and the 55dB L_{night} contour are wholly contained within Zone B and therefore the impact on the Zone B contour is neutral.	. Areas affected by both the predicted 54dB LAeq.16h contour and the 48dB L_{night} contour are wholly contained within Zone C contour and therefore the impact on the Zone C contour is neutral.
Permitted Scenario 2025	Areas affected by both the predicted 63dB LAeq.16h contour and the 55dB L_{night} contour are wholly contained within Zone A and therefore the impact to the Zone A contour is neutral	Areas affected by both the predicted 54dB LAeq.16h contour and the 55dB L_{night} contour are wholly contained within Zone B and therefore and therefore the impact to the Zone B contour is neutral	Areas affected by both the predicted 54dB LAeq.16h contour and the 48dB L_{night} contour are wholly contained within Zone C contour and therefore the impact to the Zone C contour is neutral
Proposed Scenario 2025	Areas affected by both the predicted 63dB LAeq.16h contour and the 55dB L_{night} contour are wholly contained within Zone A and therefore the impact to the Zone A contour is neutral	Areas affected by both the predicted 54dB LAeq.16h contour and the 55dB L_{night} contour are wholly contained within Zone B and therefore the impact to the Zone B contour is neutral	Areas affected by both the predicted 54dB LAeq.16h contour and the 48dB L_{night} contour are wholly contained within Zone C contour and therefore the impact to the Zone C contour is neutral
Permitted Scenario 2035	Areas affected by both the predicted 63dB LAeq.16h contour and the 55dB L_{night} contour are wholly contained within Zone A and therefore the impact to the Zone A contour is neutral	Areas affected by both the predicted 54dB LAeq.16h contour and the 55dB L_{night} contour are wholly contained within Zone B and therefore the impact to the Zone B contour is neutral	Areas affected by both the predicted 54dB LAeq.16h contour and the 48dB L_{night} contour are wholly contained within Zone C contour and therefore the impact to the Zone C contour is neutral
Proposed Scenario 2035	Areas affected by both the predicted 63dB LAeq.16h contour and the 55dB L_{night} contour are wholly contained within Zone A and therefore the impact to the Zone A contour is neutral	Areas affected by both the predicted 54dB LAeq.16h contour and the 55dB L_{night} contour are wholly contained within Zone B and therefore the impact to the Zone B contour is neutral	Areas affected by both the predicted 54dB LAeq.16h contour and the 48dB L_{night} contour are wholly contained within Zone C contour and therefore the impact to the Zone C contour is neutral

As can be seen from the above table, the impact of the proposed Relevant Action on the existing Noise Zones is considered to be neutral. As a result it is concluded that the Noise Zones in the County Development Plan will continue to be an effective tool to manage the impact of noise on future residential development and other sensitive uses such as schools, hospitals and residential care facilities. As the Noise Zones will continue to operate efficiently in the management of sensitive uses within the area surrounding the airport, the planning authority will not need to change the existing noise zones to accommodate the proposed Relevant Action or the policy environment governing development within the study area and no further review of the impact of the proposed Relevant Action on land zoning is required.

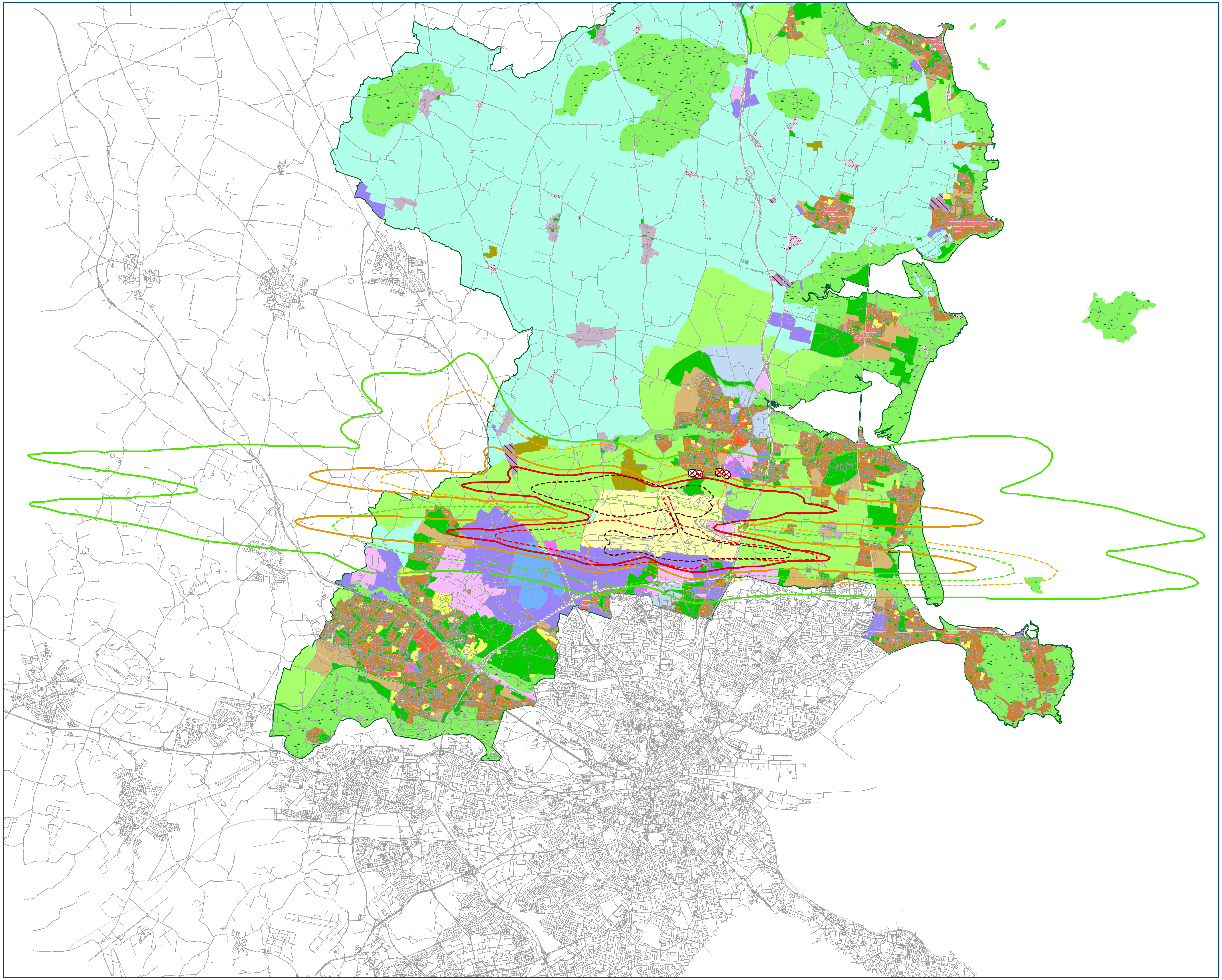
Conclusion

The proposed Relevant Action will comply with the National, Regional and Local Policy Objectives that relate to Dublin Airport and the surrounding lands. The general thrust of these policies is to achieve a balance which supports the ongoing advancement of Dublin Airport as an international hub whilst managing sensitive development within proximity to the airport through the use of land use management policies such as the Noise Zones. In this regard, the proposed Relevant Action will amend and replace the operating restrictions imposed by conditions 3(d) and 5 enabling greater connectivity and improving the airports ability to return to its consented passenger capacity in a timely manner.

The impacts of the proposed scenario in 2022, 2025 and 2035 have been assessed, showing that impact of the proposed Relevant Action to existing zoned land and the relevant zoning objectives within the County Development Plan is neutral. The existing Noise Zones and associated policy objectives within the County Development Plan are considered suitable to achieve the required outcomes sought by the County Development Plan.

Furthermore, where increases in land zonings affected by potential noise exposure as a result of the proposed scenario are predicted to occur, the existing Noise Zones within the County Development Plan are sufficient to ensure that the future development potential of zoned lands is unaffected. Where existing sensitive land uses are impacted by increased potential for noise exposure, such as the predicted increase in area affected by the 55dB Lnight contour, then mitigation measures are proposed as set out in *Chapter 13: Aircraft Noise and Vibration*. Importantly, the proposed Relevant Action will not necessitate any change to the existing Noise Zones. Furthermore, the proposed Relevant Action will not result in any change to the existing Public Safety Zones (PSZ's). As such, the existing policy environment relating to the airport and the surrounding lands will continue to operate sufficiently.

The proposed Relevant Action is fully in compliance with multi-governmental strategic objectives and policies that seek to facilitate the safe and efficient operation of Dublin Airport and foster the airport's connectiveness to the UK, Europe and wider global environment.



DUBLIN AIRPORT NOISE ZONES

Proposed Scenario with Predicted Noise Contours

2022

Noise Zones

Zone A
≥ 63 dB LAeq, 16hr and/or ≥ 55 dB Lnight

Zone B
≥ 54 dB LAeq, 16hr and < 63 dB LAeq, 16hr and ≥ 55 dB Lnight

Zone C
≥ 54 dB LAeq, 16hr and < 63 dB LAeq, 16hr and ≥ 48 dB Lnight and < 55 dB Lnight

Local Objective No.54 Removed

2022 PROPOSED SCENARIO 01

Proposed 48dB Lnight

Proposed 54 dB LAeq,16h

Proposed 55 dB Lnight

Proposed 63 dB LAeq,16h

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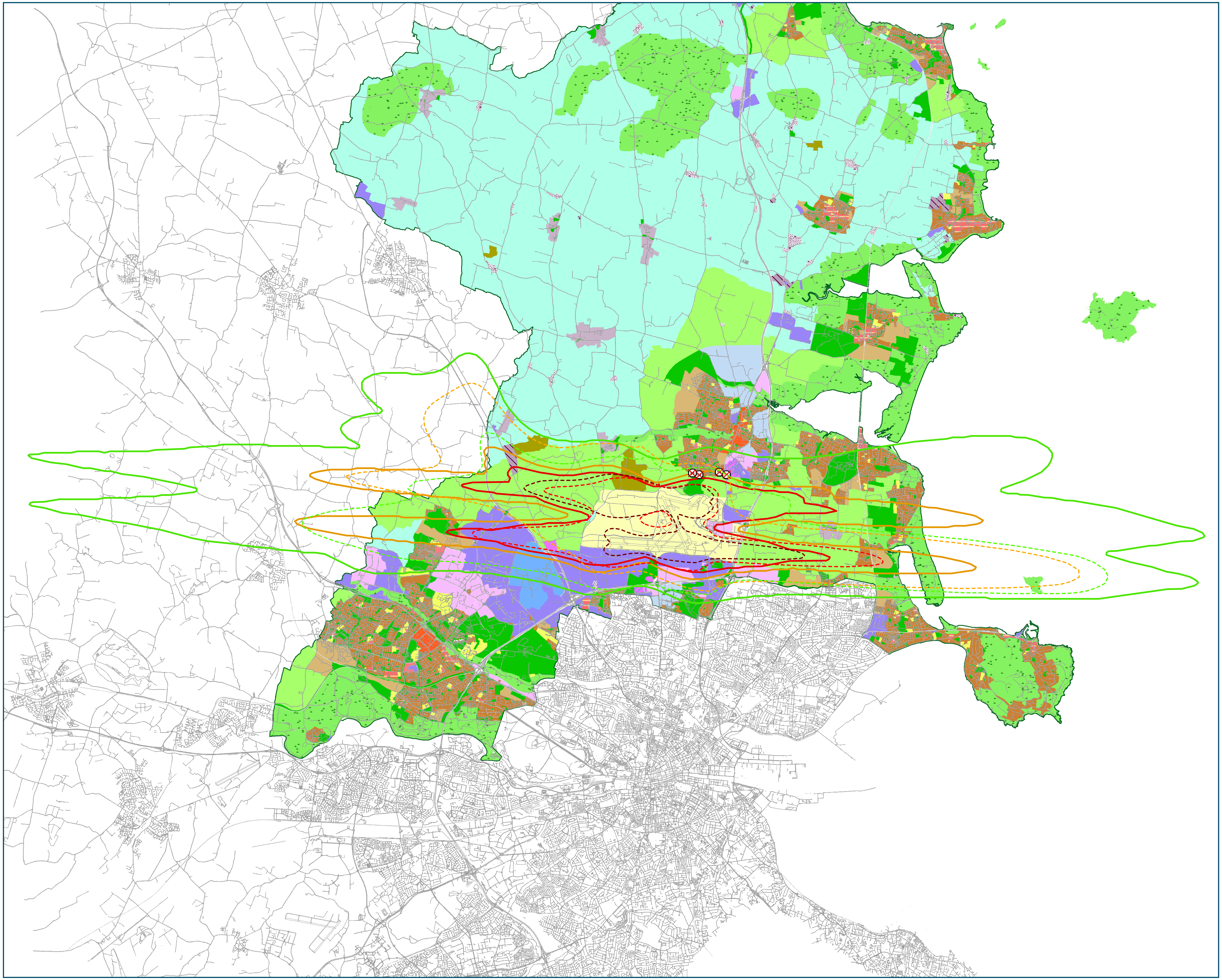

DUBLIN AIRPORT NOISE ZONES

Proposed Scenario with Predicted Noise Contours

2025

Noise Zones

Zone A
≥ 63 dB LAeq, 16hr and/or ≥ 55 dB Lnight

Zone B
≥ 54 dB LAeq, 16hr and < 63 dB LAeq, 16hr and ≥ 55 dB Lnight

Zone C
≥ 54 dB LAeq, 16hr and < 63 dB LAeq, 16hr and ≥ 48 dB Lnight and < 55 dB Lnight

Local Objective No.54 Removed

2025 PROPOSED SCENARIO 02

Proposed 48dB Lnight

Proposed 54 dB LAeq,16h

Proposed 55 dB Lnight

Proposed 63 dB LAeq,16h

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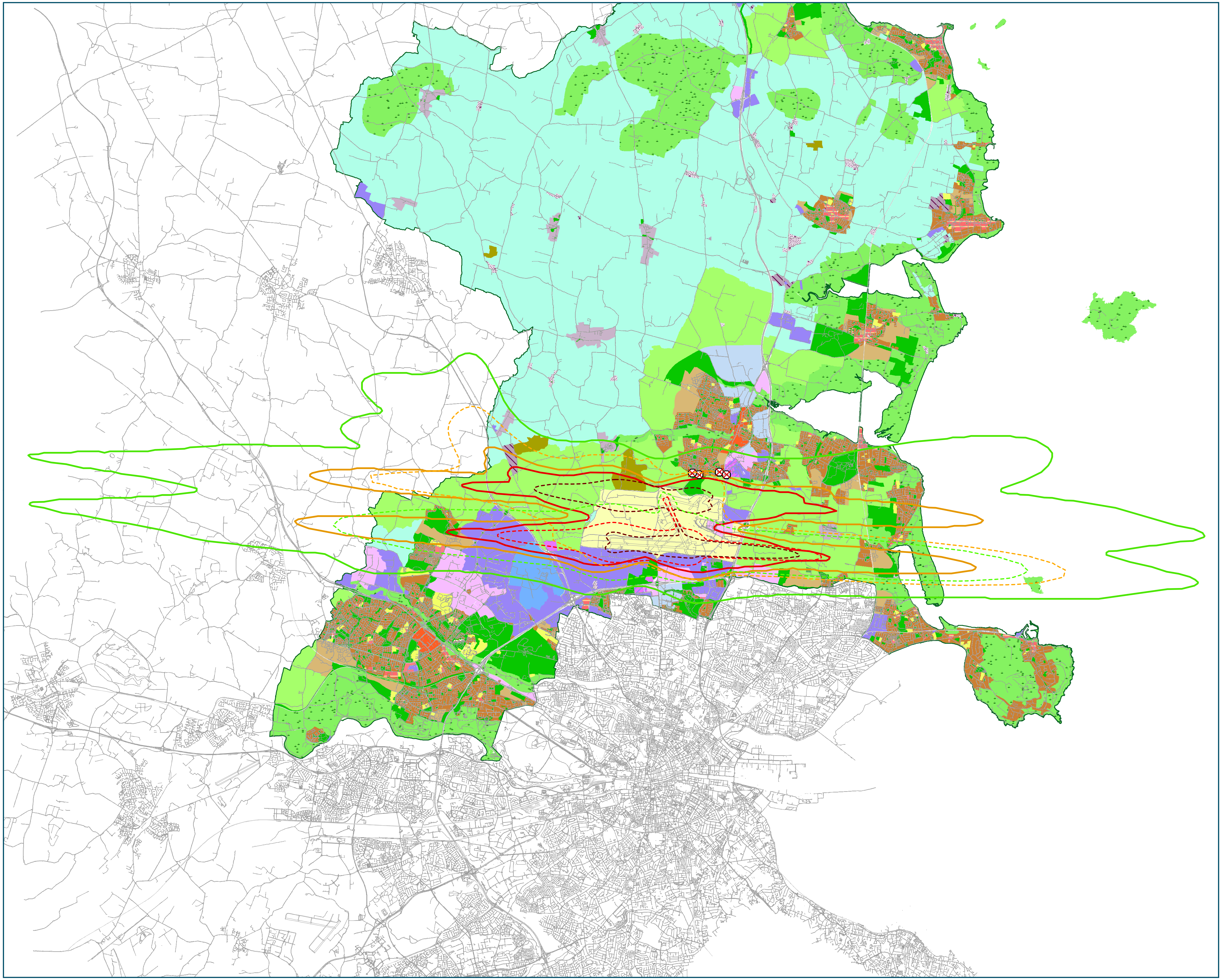

DUBLIN AIRPORT NOISE ZONES

Proposed Scenario with Predicted Noise Contours

2035

Noise Zones

Zone A
≥ 63 dB LAeq, 16hr and/or ≥ 55 dB Lnight

Zone B
≥ 54 dB LAeq, 16hr and < 63 dB LAeq, 16hr and ≥ 55 dB Lnight

Zone C
≥ 54 dB LAeq, 16hr and < 63 dB LAeq, 16hr and ≥ 48 dB Lnight and < 55 dB Lnight

Local Objective No.54 Removed

2035 PROPOSED SCENARIO 01

Proposed 48dB Lnight

Proposed 54 dB LAeq,16h

Proposed 55 dB Lnight

Proposed 63 dB LAeq,16h

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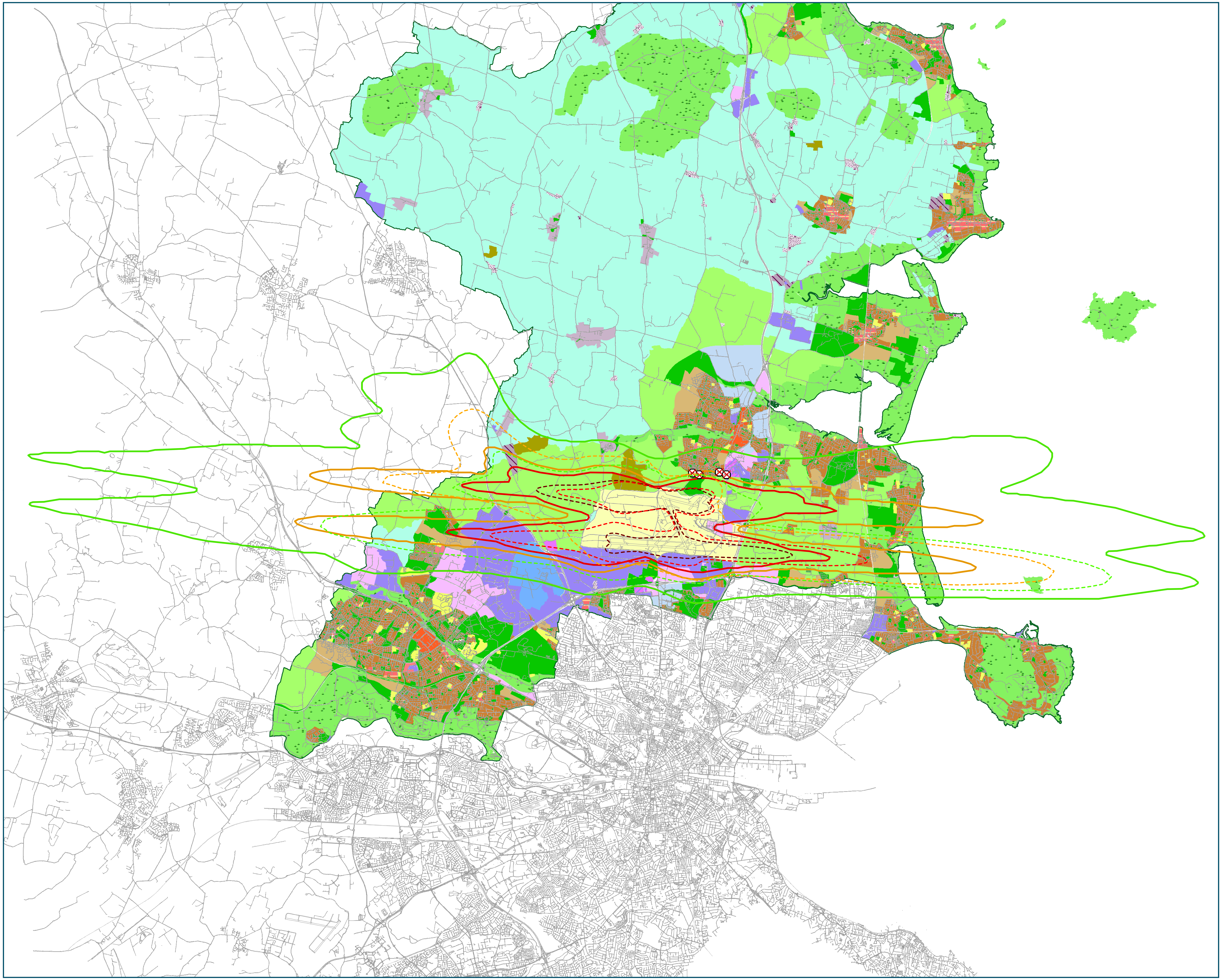

DUBLIN AIRPORT NOISE ZONES

Proposed Scenario with Predicted Noise Contours

2035

Noise Zones

Zone A
≥ 63 dB LAeq, 16hr and/or ≥ 55 dB Lnight

Zone B
≥ 54 dB LAeq, 16hr and < 63 dB LAeq, 16hr and ≥ 55 dB Lnight

Zone C
≥ 54 dB LAeq, 16hr and < 63 dB LAeq, 16hr and ≥ 48 dB Lnight and < 55 dB Lnight

Local Objective No.54 Removed

2035 PROPOSED SCENARIO 02

Proposed 48dB Lnight

Proposed 54 dB LAeq,16h

Proposed 55 dB Lnight

Proposed 63 dB LAeq,16h

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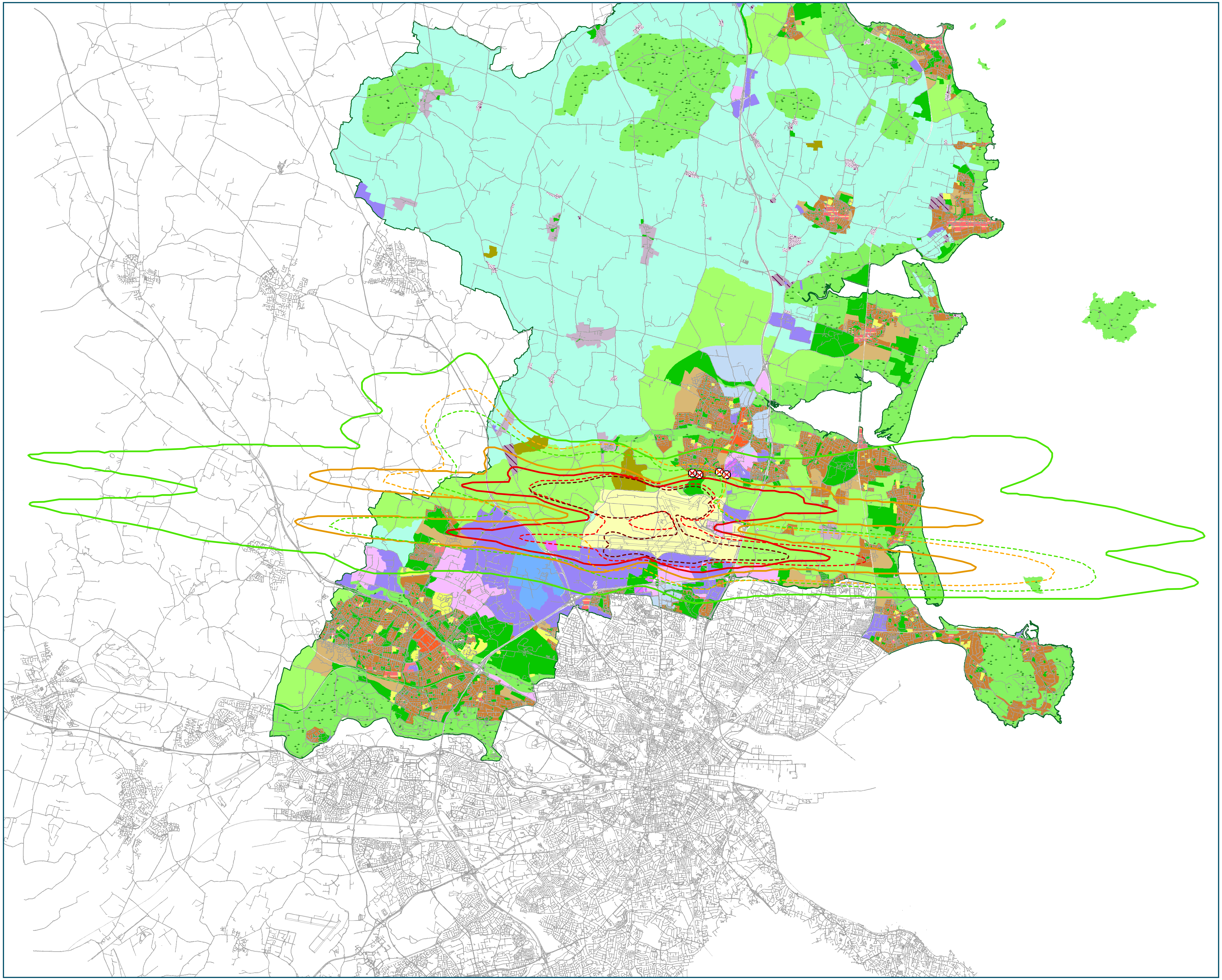

DUBLIN AIRPORT NOISE ZONES

Proposed Scenario with Predicted Noise Contours

2022

Noise Zones

Zone A
≥ 63 dB LAeq, 16hr and/or ≥ 55 dB Lnight

Zone B
≥ 54 dB LAeq, 16hr and < 63 dB LAeq, 16hr and ≥ 55 dB Lnight

Zone C
≥ 54 dB LAeq, 16hr and < 63 dB LAeq, 16hr and ≥ 48 dB Lnight and < 55 dB Lnight

Local Objective No.54 Removed

2022 PROPOSED SCENARIO 02

Proposed 48dB Lnight

Proposed 54 dB LAeq,16h

Proposed 55 dB Lnight

Proposed 63 dB LAeq,16h

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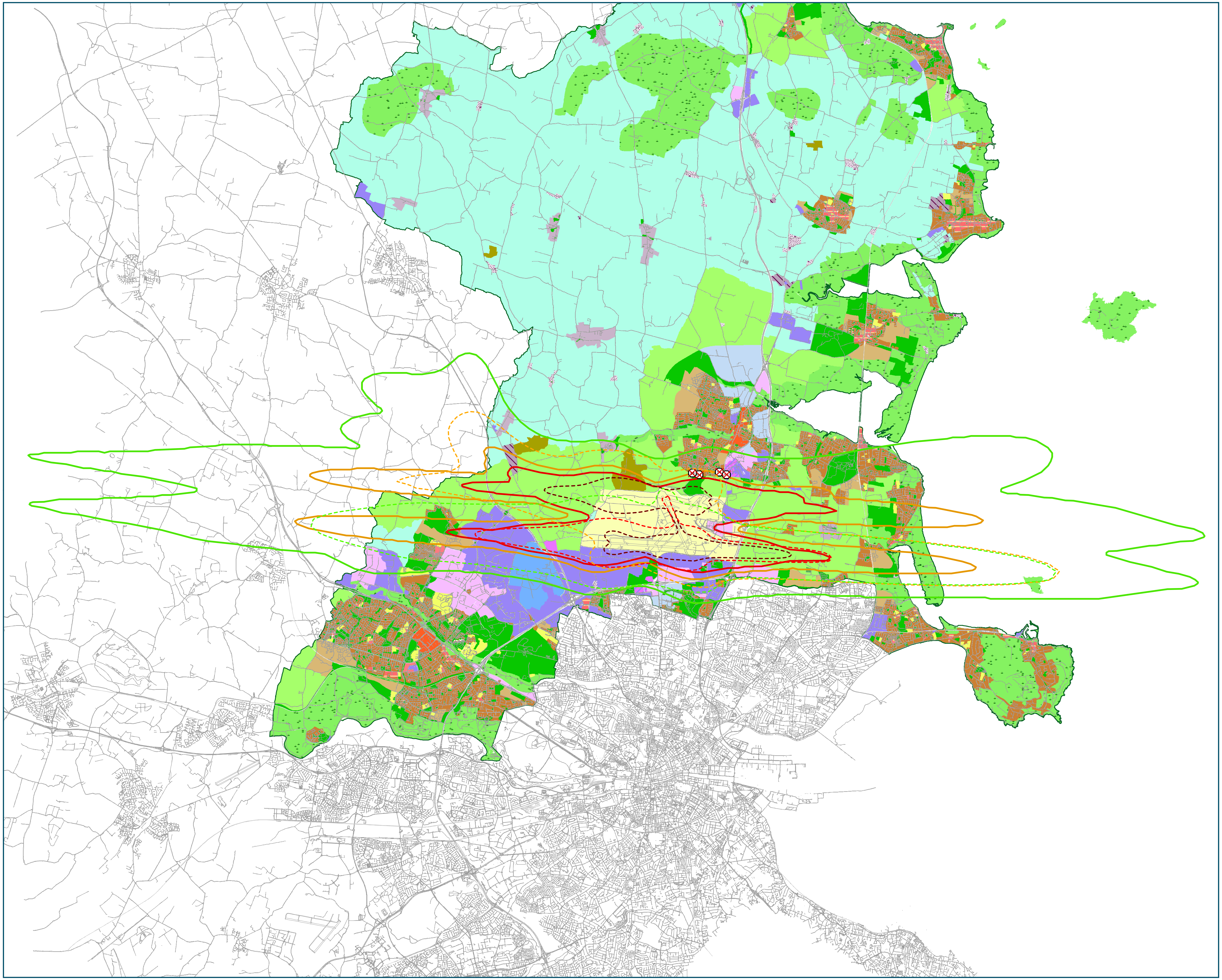

DUBLIN AIRPORT NOISE ZONES

Proposed Scenario with Predicted Noise Contours

2025

Noise Zones

Zone A
≥ 63 dB LAeq, 16hr and/or ≥ 55 dB Lnight

Zone B
≥ 54 dB LAeq, 16hr and < 63 dB LAeq, 16hr and ≥ 55 dB Lnight

Zone C
≥ 54 dB LAeq, 16hr and < 63 dB LAeq, 16hr and ≥ 48 dB Lnight and < 55 dB Lnight

Local Objective No.54 Removed

2025 PROPOSED SCENARIO 01

Proposed 48dB Lnight

Proposed 54 dB LAeq,16h

Proposed 55 dB Lnight

Proposed 63 dB LAeq,16h

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Appendix 8A. Hazard Technical Appendix

Document Classification: Class 1 - General

Technical Appendix: Crash Risk Assessment Methodology

Table of Contents

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A8.1 Introduction and Methodology Outline

A8.1.1 A variety of different models have been developed to provide quantitative estimates of the risks to third parties in the vicinity of airports, following the approach outlined in Section 8.3 of the EIAR Hazard Chapter. One such model is the UK Department for Transport (DfT) model [1,2] that was developed in the 1990s to support the development of a revised UK Public Safety Zone (PSZ) policy. That modelling approach was adopted in the study [3] of third party risks at airports in the Republic of Ireland, undertaken on behalf of the Department of Transport and the Department of Environment, Heritage and Local Government (DoEHLG), that recommended the adoption of a PSZ policy broadly similar to that in use in the UK in 2005. Taking account of the precedent set by that study and its previous use for the definition of PSZs at Dublin Airport, the DfT model has been employed as the basis for this assessment with some minor modifications.

A8.1.2 As described in the Hazard Chapter of the EIAR main report, Section 8.3, site-specific risks to the public in the vicinity of airports can be estimated quantitatively by using an empirical modelling approach, based on historical accident data that characterises risk by reference to three key parameters as follows:

- The likelihood or probability (frequency per annum) of an aircraft crash occurring during take-off or landing operations;
- The probability of impact at any specific location at or near an airport relative to the runway end and the extended centreline;
- The severity of the consequences of an impact on the ground.

A8.1.3 Model implementation is dependent upon two key sets of input assumptions:

- The number of take-off and landing operations at each runway and the associated fleet mix which determine the probability of a crash and the severity of the consequences for the operations at a given airport;
- The geometry of the runway system concerned, in the case of Dublin Airport involving the north and south parallel runways, Runway 10L/28R and Runway 10R/28L, and the cross runway, Runway 16/34 and the associated flight paths.

The various operational and risk model assumptions employed in this assessment are set out in Section A8.2A8.2.

A8.1.4 Two distinct measures are available for characterising the risks estimated by airport-related crash risk models, as follows:

- Individual risk: the annual probability of fatality for a hypothetical resident present at any given location relative to the runway threshold and associated flight paths;
- Societal risk: the annual probability of accidents causing any given number of fatalities in any particular area of development, taking account of the nature of the development, in particular the density of occupancy.

Both measures have been employed in this assessment. Detailed accounts of the assessment of the individual risks and societal risk associated with the relevant operational scenarios are presented in Sections A8.3 and A8.4A8.4.

A8.1.5 There will inevitably be limitations to the reliability of any quantitative risk model. Some consideration has been given to the possible limitations of the DfT model, as set out in Section A8.5, and it is concluded that this modelling approach, as implemented here with some minor modifications, provides a sound basis for assessing the implications for public safety of the proposal to change permitted operations at Dublin Airport.

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A8.2 Risk Model and Operational Assumptions

A8.2.1 Aircraft Crash Rates

A8.2.1 In accordance with the standard approach adopted in the UK DfT Model, historical accident rates per take-off and landing movement of different aircraft types were employed as the basis for estimating the future probability of a crash for the anticipated fleet mix operating at Dublin Airport. In the first instance, aircraft types are split according to the three engine types, as follows:

- Jet engine
- Turboprop
- Piston engine

A8.2.2 The UK DfT model identifies different crash rates according to the age of aircraft, as defined by the year of entry into service. All aircraft operating at Dublin Airport are identified as being within the latest age category with the lowest crash rates. Finally, a distinction is made between passenger and cargo operations for some aircraft types. Following a detailed review, as described in Section A8.5.1, the crash rates shown in **Error! Reference source not found.**A8.1 were identified as providing an appropriate basis for the risk modelling.

Table A8.1 – Modelling Assumptions for Aircraft Crash Rate per Million Movements

Aircraft category	***Crash rate per million movements***
Class IV Jets (passenger)	0.082
Class IV Jets (non-passenger)	0.531
Turboprops T1 (passenger)	0.254
Turboprops T1 (non-passenger)	1.68

A8.2.2 Crash Location Modelling

A8.2.3 The UK DfT crash location model provides for the determination of the probability, in the event of a crash anywhere in the vicinity of the airport, of the crash being centred at any given location, defined in terms of rectilinear coordinates by the distance relative to the runway end (y), as measured along the runway extended centreline, and displacement from the runway extended centreline (x), perpendicular to flight path. The model consists of a set of four probability density functions (pdfs) which represent the crash distributions associated with four separate accident scenarios as follows:

- Ground impacts from flight during take-off;
- Ground impacts from flight during landing;
- Take-off overruns; and
- Landing overruns.

A8.2.4 Following a detailed review, as described in Section A8.5.2, the standard functions identified in the latest published version of the UK DfT model [2] were identified as providing an appropriate basis for the risk modelling.

A8.2.5 The standard DfT model is based on the assumption that flight paths are runway-aligned throughout. In order to accommodate the curved departure paths employed for the earlier turns flown by Category A and B aircraft and the divergent departure paths employed by other aircraft, a revised approach was adopted for the treatment of the risk associated with take-off operations. In the case of these operations, the risk at any given point relative to the flight path was determined on the basis of the identified distribution functions where the y value (distance from the threshold) is measured along the line of the

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curved flight path and the x value (displacement from the flight path) is measured perpendicular to the tangent of the curve of flight path at the appropriate y value.

A8.2.3 Crash Consequence Modelling

A8.2.6 The DfT consequence model is based on the empirical relationship between the area destroyed and the size of the aircraft, characterised in terms of the maximum take-off weight allowed (MTWA), as determined by reference to the historical accident record. Following a detailed review, as described in Section A9.5.3A8.5.34, the logarithmic function identified in the latest published version of the UK DfT model [2] was identified as providing an appropriate basis for the risk modelling. This model is as follows:

$$\log_e(\text{Area destroyed}) = -6.16 + 0.474 \log_e(\text{MTWA})$$

A8.2.4 Annual Movements

A8.2.7 The assumed annual movements for the six different operating scenarios, covering the permitted operations and proposed operations in 2022, 2025, and 2035 are summarised in Table A8.2. These scenarios and assumptions are in line with the scenarios modelled for the noise assessment.

Table A8.2 – Annual Movements for 2022, 2025 and 2035 Permitted and Proposed Operations, excluding helicopters

Scenario	Annual movements
2022 Permitted Operations	165,840
2022 Proposed Operations	175,737
2025 Permitted Operations	226,772
2025 Proposed Operations	235,882
2035 Permitted Operations	235,882
2035 Proposed Operations	235,882

Source: A11267_08_CA001_5.0 Summary of Movement Data for Hazard Assessment.xslx, 21st May 2021

A8.2.5 Runway Geometry

A8.2.8 The runway threshold locations provide the primary reference points for the runway system and these are given in Irish Grid coordinates in Table A8.3. For the purposes of the assessment, it is convenient to work in terms of runway-aligned coordinates. The key reference point that has been adopted for the runway-aligned coordinate system is the Runway 10R threshold. Following the convention employed in the UK DfT model, the y direction is the direction of take-off and landing and the x direction is the lateral displacement from the runway and its extended centreline. For locations before the landing threshold (i.e. to the west of the Runway 10R threshold), y values are negative and after the threshold y values are positive. For locations to the north of the axis of the south runway, x values are negative and to the south, x values are positive. The threshold coordinates in Runway 10R threshold-aligned coordinates are also shown in Table A8.3.

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Table A8.3 – Runway Threshold Coordinates

Threshold	Irish grid coordinates		10R THR aligned	
	Easting	Northing	y (m)	x (m)
10R THR	313724.501	242706.096	0	0
28L THR	316355.946	242528.360	2637.441	0
10L THR	314313.703	244360.933	476.343	-1690.680
28R THR	316688.279	244200.344	2856.343	-1690.680
16 THR	315552.728	244371.355	1711.850	-1784.677
34 THR	316422.286	242490.397	2706.188	33.406

Source: daa supplied data: "Airfield Layout 2037 Rev 1.pdf" – document no 31.6.78-003 Rev 1 dated 29/07/2016, prepared by daa Asset Management and Development.

A8.2.9 Referring to the declared distances, the displacements of the departure ends of runway with respect to the nearest thresholds have been determined. The DER locations in Runway 10R threshold-aligned coordinates have then been determined and are outlined in Table A8.4.

Table A8.4 – Take-off Runway End Displacement from Thresholds

Take-off runway end	Displacement (m)	RWY 10R THR aligned coordinates	
		y (m)	x (m)
Runway 10L DER displacement East of Runway 28R THR	450	3306.343	-1690.680
Runway 28R DER displacement West of Runway 10L THR	280	196.343	-1690.680

A8.2.6 Flight Path Geometry

A8.2.10 The approach paths are essentially runway-aligned from before the Final Approach Fix (FAF). Typical FAF to landing threshold distances for the current instrument approach procedures in the AIP at Runway 10/28 and 16/34 vary from about 13 km to about 16 km. On that basis, it is reasonable to expect that the assumption of runway-alignment will apply to at least 13 km for approach operations which is beyond the distance where risks at potentially elevated levels of relevance to this assessment are estimated to arise.

A8.2.11 Current and future departure paths supporting this assessment are based on the detailed analysis and description of current and future departure paths provided as part of the noise assessment. The departure paths for the current standard instrument departures (SIDs) from the Southern Runway for larger aircraft within PANS-OPS Categories C and D, which form the majority of operations at Dublin Airport, are aligned with the runway for some distance after the departure end of runway (DER) before routing to the south. In practice, radar data from 2010 has shown that some of these larger aircraft perform earlier turns than described in the SIDs. During departures from the Southern Runway, Category A and B aircraft commonly turn off the extended runway centreline to the south shortly after the end of the runway, as agreed with the IAA.

A8.2.12 In order to ensure an adequate lateral separation between aircraft using the Southern Runway and those using the North Runway, proposed future Northern Runway departure routes for larger aircraft within PANS-OPS Categories C and D include a course divergence of at least 15° to the north, shortly after

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take-off at 1.06 and 1.18 nautical miles for easterly and westerly take-offs, respectively. During departures from the Northern Runway, Category A and B aircraft are expected to execute an earlier turn and leave the extended runway centreline to the north shortly after the end of the runway.

A8.2.13 Data for 43 discrete departure routes for 2022, 2025 and 2035 operational forecasts has been provided by the noise consultant. Inspection of the individual departure routes determined that some individual routes diverged well beyond the expected boundaries of the 10^{-6} risk contours and for modelling of the aircraft crash risk out to areas where risk are at elevated levels of interest in this study, these routes could be combined. On that basis, 20 routes have been identified for use within the aircraft crash risk model. The track data for these routes has been provided in the form of .shp files which define a set of points along each track in Irish Transverse Mercator (ITM) coordinates. The crash risk model developed for modelling curved departures requires tracks to be defined in terms of straight elements and fixed radius turns over prescribed angles. Therefore, a best fit approach was adopted to determine a geometrically precise representation of each of the 20 identified routes. Details of the geometric specification for the modelled routes are summarised in Annex 1.

A8.2.7 Fleet Mix Assumptions

A8.2.14 Detailed fleet mix specifications have been provided in the form of busy day schedules. Fleet mixes for each individual arrival and departure route have been determined, following detailed analysis of future aircraft operations taking account of the parallel runway operational constraints. These fleet mixes were primarily generated for the noise assessment. Where applicable, analysis of the busy day schedules to determine representative crash rates and MTOW has been undertaken. Fleet mixes for the 20 combined departure routes identified for aircraft crash risk modelling purposes were determined and are reproduced in Annex 2 along with the fleet mixes for departures from the crossing runway and arrivals at all runways.

A8.3 Individual Risk Contour Modelling

A8.3.1 In the first instance, the annual average crash rate and average area destroyed was determined for the relevant arrival and departure routes. In all cases, the movement-weighted average was employed: i.e. the contribution to the average from each aircraft type was weighted in proportion to the fraction of aircraft of that type within the fleet mix. These values are summarised in Table A8.5.

Table A8.5 – Summary of Individual Risk Contour Modelling Parameters

Scenario	Annual movements	Crash rate per million movements	Crash rate per annum	Destroyed area (hectares)
2022 Permitted Operations	165,840	0.1234	0.0205	0.399
2022 Proposed Operations	175,737	0.1210	0.0213	0.401
2025 Permitted Operations	226,772	0.1132	0.0257	0.411
2025 Proposed Operations	235,882	0.1120	0.0264	0.413
2035 Permitted Operations	235,882	0.1118	0.0264	0.419
2035 Proposed Operations	235,882	0.1120	0.0265	0.419

A8.3.2 The individual risk at any point was then determined by reference to the crash location element of the UK DfT model, integrating over the destroyed area and determining the contributions from each relevant take-off and landing operation at each runway in accordance with the route specific fleet mix data provided in Annex 2. The risk contours determined using this approach are shown in the Hazard Chapter of the Main EIAR.

A8.3.3 The contour lengths have been assessed against the lengths out to which the modelled departure routes diverge from those routes which have not been explicitly modelled. This assessment has demonstrated

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that the areas across which the departure routes are modelled is adequate to provide reliable results out to the limits of the 1 in 1,000,000 per annum contours and beyond.

A8.4 Societal Risk Modelling

A8.4.1 Methodology Outline

A8.4.1 Societal risks were estimated using the same basic risk modelling approach as outlined earlier in Section A8.2A8.2 and implemented for individual risk estimation, as described in Section A8.3. However, for societal risk estimation it is also necessary to consider the various sites at potential risk specifically, taking account of the different levels of occupancy across the areas surrounding the airport. The societal risks associated with residential sites were assessed using an approach involving the following steps:

1. Identification of residential properties in the vicinity of Dublin Airport using Geodirectory data, the determination of their locations relative to the flight paths and runway ends and the estimation of the occupancy of each property.
2. Allocation of the identified residential properties to a set of 100 by 100 m grid squares referenced against the Runway 10R threshold and the determination of the density of occupation of each grid square by reference to the location and occupancy data determined under step 1.
3. Estimation of the probability of a crash in each of these 100 by 100 m grid squares containing residential properties in the event of crash somewhere at Dublin Airport during either take-off or landing, by reference to the crash location distribution model.
4. Estimation of the annual probability of a crash of each different aircraft type, by reference to the identified annual fleet mixes for operations, the annual number of movements and the crash rates applicable to each aircraft type.
5. Estimation of the area destroyed in the event of a crash of each different aircraft type, using the crash consequence model and making reference to the relevant aircraft weights.
6. Estimation of the numbers of fatalities in the event of a crash of each aircraft type in each of the 100 by 100 m grid squares, by reference to the outputs of step 2 (the densities of square occupation) and of step 5 (the area destroyed for each aircraft type).
7. Estimation of the probability of occurrence of accidents causing any specified number of fatalities, by reference to the outputs of step 6 (number of fatalities for a crash of each aircraft type in each square) and of steps 3 and 4 (together giving the annual probability of a crash of each aircraft type in each square).

A8.4.2 For commercial sites and healthcare facilities, a broadly similar approach was employed, involving the following steps:

1. Identification of relevant commercial sites and healthcare facilities in the vicinity of Dublin Airport and the determination of their locations relative to the flight paths and runway ends. By reference to the Geodirectory data, the locations of all known commercial sites were plotted on the available Google Earth satellite imagery to provide a basis for the systematic review of all commercial sites.
2. The estimation of the numbers of people present at each commercial site and healthcare facility and the estimation of the areas of occupied buildings at the sites, providing estimates for the target areas at potential risk and the densities of occupation.
3. Estimation of the probability of a crash at each commercial site and healthcare facility in the event of a crash somewhere at Dublin Airport during either take-off or landing, by reference to the site area and the crash location distribution model.
4. Estimation of the annual probability of a crash of each different aircraft type, by reference to the identified annual fleet mixes for operations, the annual number of movements and the crash rates applicable to each aircraft type.
5. Estimation of the area destroyed in the event of a crash of each different aircraft type, using the crash consequence model and making reference to the relevant aircraft weights.
6. Estimation of the numbers of fatalities in the event of a crash of each aircraft type at each of the identified commercial sites and healthcare facilities, by reference to the outputs of step 2 (the densities of square occupation) and of step 5 (the area destroyed for each aircraft type).

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7. Estimation of the probability of occurrence of accidents causing any specified number of fatalities, by reference to the outputs of step 6 (number of fatalities for a crash of each aircraft type in each square) and of steps 3 and 4 (together giving the annual probability of a crash of each aircraft type at each site).

A8.4.3 The outputs of steps 7 of the approaches for residential sites, commercial sites and healthcare facilities provide the basis for describing the range of possible outcomes of aircraft accidents at residential, commercial sites and healthcare facilities and their probabilities of occurrence in quantitative terms for subsequent evaluation against the identified criteria for risk significance. These various steps of the overall assessment process are described in turn in the following sections of this appendix.

A8.4.2 Buildings Locations and Occupancy

A8.4.4 The population and dwelling data provided by the noise consultant for use in the aviation modelling consisted of three tables as follows:

- General dwelling and population data based on Geodirectory Q2 2019 data combined with 2016 census data providing population by small area from the Central Statistics Office.
- A list of significant and relevant permitted developments based on planning submissions.
- A list of community buildings in terms of educational, religious and healthcare establishments.

A8.4.5 The general dwelling and population data within the first two categories provided by the noise consultant covers relevant residential or mixed-use sites. It is standard practice in risk modelling to assume 100% occupancy for residential buildings [4] which will be conservative. Lower occupancy factors are considered to be applicable in the assessment of commercial facilities. For mixed use buildings for which the predominant use is residential, the conservatism associated with the assumed 100% occupancy is considered to address the likely occupancy associated with commercial use.

A8.4.6 The dwelling and population data based on geodirectory Q2 2019 and permitted developments have been combined and assessed in accordance with the residential building methodology outlined above. The educational and religious establishments have not been included in the assessment, partly due to double counting as the majority of the population which would attend these facilities will have been accounted for in the residential data and also to account for the relatively low occupancies that can be expected to apply at these facilities.

A8.4.7 The healthcare facility data provided only the names of these establishments and Irish Grid coordinates for their locations. Healthcare facilities includes public and private hospitals, day care centres and nursing homes.

A8.4.3 Treatment of Residential Building Use

A8.4.8 The population within any defined area relative to the runways at Dublin Airport can be determined by reference to the coordinates of individual dwellings within that area, as given in the inventory in the Irish Grid system, and the average population data specific to each individual dwelling. In the first instance, the residential building locations were determined in runway-aligned coordinates, referenced against the 10R runway threshold. Next, the density of occupation within each 100 m x 100 m square referenced with respect to the runway threshold and runway extended centreline was determined in terms of the number of individuals per hectare.

A8.4.9 As noted earlier, in accordance with established HSA best practice, the occupants of the household are conservatively assumed to be permanently resident. In practice, the residents of these households will be subject to a lower level of risk in their homes when account is taken of the time spent at other locations. People will be subject to risks outside their homes if working at or otherwise congregating at other sites in the vicinity of the airport. To some extent at least, the assumption of permanent occupancy of residential properties will account for the risks to people at other sites. However, this balancing of the risks at residential and other locations will be dependent upon the overall distribution of residential buildings compared with the distribution of the other building uses. Where the distributions of residential and commercial buildings are well matched, the over-counting of residential buildings risks arising from the assumption of permanent occupancy may effectively address the risks associated with commercial

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buildings. Where the distributions are not well matched, this may not be the case and it may be necessary to give more specific consideration to the risks associated with commercial sites.

A8.4.4 Treatment of Commercial Building Use

A8.4.10 The noise consultant dwelling data does not include any commercial buildings and is therefore representative of the residential and general mixed-use buildings across the Dublin area. Comprehensive inclusion of all the smaller commercial buildings in the societal risk assessment is therefore not practical. That approach would provide for a level of double counting due to the assumption of permanent occupancy of residential properties and would lead to over-estimates of the risk. On the other hand, where there are commercial uses that involve relatively high densities of occupation that are located in higher risk areas close to the runway ends and extended centreline, a failure to take account of the risks associated with these commercial uses may lead to an under-estimation of the risks. The approach to the treatment of the risks associated with commercial sites has been to review the locations of the commercial sites in relation to the locations of residential sites and include identifiable areas of higher density of commercial use in areas of relatively high risk in the societal risk assessment.

A8.4.11 An initial review of the commercial building locations has shown that a large proportion are small sites that are distributed in a manner that is generally consistent with the more general pattern of development in the vicinity of the airport. It has been assumed that the risks associated with these smaller sites will be adequately addressed by the assessment of risks to residential properties, assuming permanent occupancy. In addition to those sites, a number of larger sites that are closer to the airport and potentially subject to higher than average risk levels have been identified. Specific attention has therefore been focused on these sites. Sites falling within two groups have been considered: those within the Dublin Airport Campus and those outside the Dublin Airport Campus.

A8.4.12 For sites outside the Dublin Airport Campus, the number of cars in car parks, as determined by reference to Google earth satellite images, has been employed as the basis for estimating the number of staff present during normal working hours. Central Statistical Office data for modes of travel to work for Fingal gives a value of 66.3% for the number of people driving to work. The number of cars associated with any given facility, multiplied by a factor of 1.5, therefore provides an estimate for the number of staff present. The areas covered by the different commercial buildings that represent the size of the targets at risk from aircraft crash, and the densities of occupation were determined by approximate measurements made from Google earth satellite images. Health and Safety Authority Guidance identifies the following percentage occupancy times for commercial facilities for use in risk assessments: Factories 75%, Places of entertainment 50%, Shops and supermarkets 50%, Warehouses 50%, Offices 30%. A value of 50% has been assumed for all the commercial sites outside the Dublin Airport Campus. The sites that have been included in the assessment, their locations, sizes and occupancy characteristics are summarised in Table Table 8.6.

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Table 8.6 – Characteristics of commercial sites outside the Dublin Airport Campus

Site description	Latitude	Longitude	Area in hectares	Occupants	Density of occupation
Dublin Airport Business Park	53°25'33.71"N	6°13'22.47"W	2.782	515	185.09
Coachman's Inn	53°25'56.95"N	6°13'45.03"W	0.129	100	773.69
Units N of Kettle Lane	53°26'16.03"N	6°13'35.30"W	0.480	110	228.98
Swords Airside Industrial Estate	53°26'45.77"N	6°13'25.62"W	5.933	1710	288.20
Santry Retail and Business Parks	53°24'26.33"N	6°14'34.15"W	25.454	1437	56.46
Horizon Logistics Park	53°25'05.60"N	6°17'14.16"W	1.635	204	124.79
Dublin Airport Logistics Park	53°25'06.87"N	6°18'43.36"W	3.833	495	129.13
Northwest Business Park (North)	53°25'12.08"N	6°20'52.17"W	4.248	347	81.70
Northwest Business Park (South)	53°24'36.69"N	6°21'13.07"W	21.238	1735	81.70
Damastown Industrial Park	53°25'09.56"N	6°24'47.50"W	10.805	2918	270.06
Food Central	53°26'57.40"N	6°16'50.34"W	6.860	2385	347.67

A8.4.13 For the Dublin Airport Campus, an average of 6,450 staff members have been identified as working on campus on a daily basis in 2015 with a projected increase to 9,967 staff members in 2035. These staff have been allocated to different facilities within the campus. Given the hours of operation of the airport, some activities can be expected to involve two shifts per day, such that the number of staff present at any one time will be less than this daily total of 6,450. Some activities, e.g. office staff, are expected to involve a single daily shift. The campus comprises the following main areas:

- The Terminal Complex;
- The Old CTB Complex;
- The MSCP Complex;
- Cloghran West;
- Cloghran East;
- Eastlands;
- Corballis Park;
- Westland Area;
- Westpoint.

A8.4.14 For some of the more outlying areas, the numbers present can be estimated by using the method applied to commercial sites outside the Airport Campus, based on the number of cars in adjacent car parks (e.g.Corballis Park, Westland, Westpoint and Cloghran East). This approach cannot be reliably applied to other areas closer to the terminal complex where there are larger areas associated with car parking that cannot necessarily be related to staff use. For office buildings, floor area estimates are available. An average of 10.9 m^2 per member of office staff, based on value in a recent UK study, has been assumed to provide estimates of office staff numbers by making reference to office floor area data which was provided by daa Commercial & Asset Care Departments.

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A8.4.15 Based on the staff number estimates derived in accordance with the approach set out above, the remaining number of staff was determined and these staff were allocated to the terminal areas. A small number of these staff were first allocated to the hangar areas and the remainder were allocated to the Terminal 1 and Terminal 2 complexes. Staff have been apportioned between the 2 terminals and 4 associated piers at an assumed equal density, having regard to the areas of each facility and having further regard to the number of levels in the terminal buildings, as compared to the piers. Given that all of the majority of staff can be expected to be within facilities that are in broadly similar locations, the accuracy of these allocations is considered not to be a critical factor in the reliability of the assessment. Using this approach, the locations, sizes and occupancy characteristics of sites within the Dublin Campus summarised in Table A8.7 were estimated. These values apply to 2015. They were increased by factors of 1.22, 1.30 and 1.56 to give estimates for 2022, 2025, and 2035 respectively, to take account of the expected increases in staff numbers. It should be noted that these increases are expected to be conservative since they were made without taking any account of the impact of the Covid 19 pandemic.

Table A8.7 – Characteristics of Sites within the Dublin Airport Campus

Site description	Latitude	Longitude	Area in hectares	Occupants	Occupancy factor	Density of occupation
Terminal 1	53°25'37.86"N	6°14'39.19"W	2.043	496	100%	242.84
Terminal 2	53°25'32.52"N	6°14'24.85"W	3.060	744	100%	243.14
Pier 1	53°25'49.99"N	6°14'55.31"W	0.938	114	100%	121.54
Pier 2	53°25'42.38"N	6°14'49.72"W	0.450	55	100%	122.22
Pier 3	53°25'35.37"N	6°14'43.26"W	0.455	55	100%	120.88
Pier 4	53°25'25.68"N	6°14'35.35"W	1.200	146	100%	121.67
Cloghran House	53°25'29.91"N	6°13'57.60"W	0.351	447	50%	1273.50
Taxi catering	53°25'30.33"N	6°13'53.77"W	0.225	120	100%	533.33
Radisson	53°25'35.86"N	6°13'56.95"W	0.385	20	100%	51.99
Head Office Area	53°25'39.56"N	6°14'12.17"W	0.511	1282	50%	2508.81
Maldron Hotel	53°25'38.38"N	6°14'04.33"W	0.263	20	100%	76.19
Macdonalds / Topaz	53°25'44.28"N	6°14'07.77"W	0.161	15	100%	93.17
OCTB area	53°25'45.38"N	6°14'46.38"W	0.926	1303	50%	1406.82
Corballis Park	53°25'23.47"N	6°14'07.10"W	2.996	780	50%	260.31
Eastlands car rental	53°25'15.57"N	6°13'27.03"W	0.540	15	100%	27.78
ALSAA Sports	53°25'20.01"N	6°13'45.68"W	0.450	10	100%	22.22
W Hangar	53°25'49.72"N	6°14'39.59"W	0.845	10	100%	11.83
Mid Hangar group	53°25'49.38"N	6°14'26.97"W	2.500	10	100%	4.00
E Hangar	53°25'47.11"N	6°14'10.87"W	0.369	10	100%	27.14
Westland Area	53°25'46.69"N	6°15'46.83"W	1.184	240	100%	202.74
Westpoint	53°25'06.86"N	6°15'52.90"W	0.359	38	50%	105.76

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A8.4.16 The values in Table A8.7 refer to staff only. The numbers of passengers present have been estimated by reference to the dwell times for departing and arriving passengers, the total annual throughput of passengers and the operating hours of the airport. On that basis, the average numbers of passengers present in the terminal complex shown in Table A8.8 have been estimated. These numbers have been assumed to be evenly distributed about the main terminal building and two piers of both terminal complexes. The same average value has been assumed to apply throughout the operating hours of the airport.

Table A8.8 – Estimates for numbers of passengers present in the terminal complex at any time

Scenario	Passengers present
2022 Permitted Operations	3,814
2022 Proposed Operations	4,281
2025 Permitted Operations	5,916
2025 Proposed Operations	6,169
2035 Permitted Operations	6,013
2035 Proposed Operations	6,266

A8.4.17 The Radisson and Maldron Hotels have 229 and 251 rooms, respectively. Assuming an average room occupancy of around 1.5 guests gives 345 and 377 hotel guests, respectively at these two hotels. Guests have been assumed to be present at that level for 50% of the operating hours of the airport. For the remaining period of operation, a guest occupancy of 100 has been assumed. Based on the number of cars in the car park at Kealeys of Cloghran, the number of occupants has been estimated at around 100. For the car rental facility, 50 customers collecting or returning cars has been assumed. Based on the car park occupancy in the available Google earth satellite images, the typical occupancy of users of the ALSAA Sports Fitness & Social Association facility is estimated to be 200. For the MacDonalds restaurant and Topaz petrol stations, 50 customers have been assumed. An occupancy factor of 100% has been assumed for these facilities.

A8.4.4 Treatment of Healthcare Facility Use

A8.4.18 A review of the healthcare facilities was undertaken to estimate the population and areas which would apply. The populations were estimated by reference to the number of beds at each facility with reference to hospital care quality reports or websites describing the facilities. A staffing ratio of 1:1 of beds to staff was assumed to apply. This is likely to be conservative in the majority of cases, especially in respect of smaller nursing homes. The site areas were estimated by reference to google earth satellite imagery of each facility. A table of the assumed populations and areas at each healthcare facility is provided in Annex 3.

A8.4.5 Societal Risk Estimates

A8.4.19 Societal risks were estimated separately for Airport Campus sites and all non-airport sites and for all sites combined. These estimates were characterised by a number of measures, as follows:

- The overall frequency of accidents;
- The average number of fatalities involved;
- The expectation value, representing the average number of fatalities per annum;
- The “Scaled Risk Integral” (SRI) Index, as normally employed in land-use planning in the vicinity of major hazard (COMAH) sites;
- FN curves for the full range of accident frequencies and consequences.

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A8.4.20 The overall frequencies of accidents are estimated to be of the order of 0.025 per annum (about 1 in 40 years) and are predicted to rise from a baseline rate for the 2022 permitted operations of 1 in 49 years to a rate of 1 in 38 years for the 2035 proposed operations. The majority of accidents are predicted to occur at unoccupied sites and therefore not to give rise to any third party fatalities. Overall, around 4% of accidents are estimated to give rise to third party fatalities. The frequencies of accidents giving rise to third party fatalities are estimated to be of the order of 0.001 per annum (about 1 in 1,000 years) and are predicted to rise from a baseline rate for the 2022 permitted operations of 1 in 1,224 years to a rate of 1 in 927 years for the 2035 proposed operations. This increase largely reflects the increase in the number of movements between the two cases. The average number of third party fatalities per event is estimated to be around 17-18 for locations outside the airport campus and around 21-24 for all locations. These key measures of the risks are summarised in Tables 8.6 and 8.10 of Hazard Chapter in the Main EIS.

A8.4.21 The societal risk FN curves corresponding with the permitted operations are shown in Figure 8-5 and those for proposed operations are shown in Figure 8-9 of the Hazard Chapter in Main EIS. The FN curves for all sites and for sites excluding the Airport Campus sites are shown separately in these figures.

A8.4.22 A number of conclusions can be drawn from the data summarised in Tables 8-6 and 8-10 of the Hazard Chapter in the Main EIS and the FN curves shown in Figures 8-5 and 8-9, as follows:

- The risks for all cases are above the lower limit of negligible risk identified by the UK Health and Safety Executive.
- The risks for the 2022, 2025 and 2035 permitted and proposed operations are below the local scrutiny line and below the reference point for potentially intolerable risk identified by the UK Health and Safety Executive.
- The increases in the estimated risk for the proposed operations compared with the permitted operations in both 2022 and 2025 are relatively small (e.g. between 3.6% and 3.1% for 2022 and 2025, respectively, as measured in terms of the expectation value) and negligible for 2035 operations. Such differences can be considered to be negligible in the context of the overall criteria for judging societal risk significance: i.e. the risks levels all sit within the same region of the FN risk significance criteria, centrally between the identified limits defining “negligible” and “significant” risk levels.
- The levels of risk for the off-airport sites, as measured in terms of the expectation value, are roughly 2-4 times greater than levels for the airport campus and the characteristics of the risks in these different areas are substantially different. The likelihood of a crash causing fatalities at off-airport sites is around 50 times greater than the likelihood of a crash causing fatalities within the airport campus, reflecting the large area across which this risk is spread and larger number of off-airport sites at potential risk. The numbers of fatalities estimated for crashes at airport campus sites is substantially greater than the numbers expected for crashes off-airport, reflecting the generally higher densities of occupation of airport sites.

A8.4.23 Finally, the risks have been measured in terms of the Scaled Risk Integral (SRI), as identified by the Health & Safety Authority for use in respect of land-use planning in the vicinity of major hazard (COMAH) sites, and are summarised in Table A8.9Table . The 2022 baseline SRI value for off-airport sites is around 63,863, within the “moderate effects” category identified in respect of this significance criterion. These risks are expected to increase with the increase in movement numbers.

A8.4.24 For the 2035 proposed operations, the SRI value for off-airport sites is estimated to increase to around 91,838. The total SRI values for all sites are within the “moderate effects” significance category for all cases.

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Table A8.9 – Scaled Risk Integral (SRI) estimates for off-airport and airport campus sites

Scenario	SRI for non-airport sites	SRI for airport campus	SRI for all sites
2022 Permitted operations	63,863	38,033	101,896
2022 Proposed operations	65,718	42,919	108,636
2025 Permitted operations	87,521	70,843	158,363
2025 Proposed operations	89,861	74,924	164,785
2035 Permitted operations	92,052	85,182	177,234
2035 Proposed operations	91,838	85,465	177,303

A8.5 Risk Modelling Assumptions Review

A8.5.1 As has been noted earlier in Section A8.1, there will be limitations to the reliability of any empirical quantitative risk model of the type employed in this assessment. Taking account of the precedent set by the previous DoEHLG study, the DfT model has been identified initially as being favoured for use in the current assessment. The potential limitations of that model have been reviewed in some detail to confirm that it can be considered appropriate for its intended use and to identify any modifications that might be made to improve its reliability. This section sets out the findings of that technical review to support the modelling approach that has been adopted, as set out in the preceding sections of this Appendix.

A8.5.1 Aircraft Crash Rates

A8.5.2 The UK DfT Model employs historical accident rates per take-off and landing movement of different aircraft types as the basis for estimating the future probability of a crash for a defined fleet mix operating at any given airport. A number of criteria are employed for characterising different aircraft types with different crash rates. In the first instance, aircraft types are split according to the three engine types, as follows:

- Jet engine
- Turboprop
- Piston engine

A8.5.3 The second main division is then made according to the age of the aircraft. Western-built jet airliners are divided into the following categories:

- Class I: First Generation Jets, e.g. Comet, Boeing 707
- Class II: Second Generation Jets, e.g. B727, VC-10
- Class III: Early Wide Bodied Jets, e.g. B747, Tristar
- Class IV: Subsequent Types, e.g. Airbus 310, B757

A8.5.4 In addition to identifying crash rates for those categories of western-built jet airliners, the UK DfT model identifies crash rates for executive jets and "eastern jets", the latter comprising those jet airliners aircraft built in the former Soviet Block. Turboprop driven aircraft are split into two categories as follows:

- Those first delivered in or after the 1970s (T1)
- Those first delivered earlier (T2)

Finally, a distinction is made between passenger and cargo operations for some aircraft types.

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A8.5.5 The forecast fleet mixes at Dublin Airport for 2022, 2025 and 2035, as set out in Annex 2, have been reviewed to determine which of these categories of aircraft it includes. Detailed fleet mix specifications for the scenarios, covering the key risk characteristics of the aircraft types concerned, have been developed from those specifications. The jet airliners are all in the Class IV category.

A8.5.6 All of the turboprop driven aircraft in the fleet mix have been determined to be within the T1 category. Most of these aircraft were introduced either in the 1980s or 1990s.

A8.5.7 The UK DfT model further divides the Class IV jet and T1 turboprop categories into passenger and non-passenger operations. No age-related or passenger/non-passenger subdivisions are identified for executive jets or piston engine-driven aircraft.

A8.5.8 When the UK DfT model was first developed and published in 1997, the crash rate estimates for the aircraft within the different categories were made publicly available. To take account of the improvements in the safety performance in civil aviation since those estimates were first made, the crash rate estimates have been up-dated periodically. The most recent estimates currently available for use in this assessment, identified in a 2008 study [5], are summarised in Table A8.10. Taking account of the established trends towards lower crash rates, estimates determined using the most up-to-date accident and movement statistics may be slightly lower than those identified in the table. However, the rates of decline over a ten year period can be expected to be relatively small. The available estimates given in the table are conservative and, for the most part, are considered appropriate for the assessment.

Table A8.10 – Estimates for crash rate per million movements (DfT model dataset)

Aircraft category	Crash rate per million movements
Class IV Jets (passenger)	0.082
Class IV Jets (non-passenger)	0.531
Turboprops T1 (passenger)	0.254
Turboprops T1 (non-passenger)	1.68
Executive Jets	2.23
Piston Engine	3.23

A8.5.9 There is a potential concern that the non-passenger T1 turboprop crash rate of 1.68 per million movements may be unrepresentative of those types of operations at Dublin Airport. However, there is no readily available alternative value that can be shown to be representative of these sorts of operations at Dublin Airport. T1 turboprop cargo operations make up a small proportion of the forecast fleet mix (around 0.5% or less, according to the scenario) and the aircraft involved are not large (MTOW=23 tonnes). The use of a substantial over-estimate for the crash rate of this aircraft type should therefore not have a significant impact on the overall findings of the assessment and, in the absence of a readily available alternative value, the DfT model value shown in Table 8.10 has therefore been employed in this assessment.

A8.5.2 Crash Location Modelling

A8.5.10 The UK DfT crash location model provides for the determination of the probability, in the event of a crash anywhere in the vicinity of the airport, of the crash being centred at any given location, defined in terms of rectilinear coordinates by the distance relative to the runway end and the runway extended centreline. The model consists of a set of four probability density functions (pdfs) which represent the crash distributions associated with four separate accident scenarios as follows:

- Ground impacts from flight during take-off;
- Ground impacts from flight during landing;

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- Take-off overruns; and
- Landing overruns.

A8.5.11 These empirical distributions were determined by fitting mathematical functions to the crash locations identified in the historical accident record. They have been employed as described in the identified references. Some comment on the mathematical functions employed and their potential limitations and reliability is provided here.

A8.5.12 Four primary limitations in the DfT crash location model are identified as follows:

- The over-concentration of crash locations on the runway extended centreline;
- The approach to the treatment of overruns;
- The use of the departure end of runway as the coordinate system origin for take-off accidents;
- The assumption that departure routes are confined to the runway extended centreline.

These four issues are discussed in turn.

Over-concentration of crash locations on the runway extended centreline

A8.5.13 As noted earlier, the crash location model consists of probability distribution functions that fit the accident locations reported for historical accidents. A Weibull distribution was selected to fit the variation of the probability laterally from the runway extended centreline (the x direction according to the convention adopted in the DfT model) for the reported historical accident locations. The Weibull distribution tends to infinity at $x = 0$ which can be seen to be physically unrealistic. The crash location probability at the centreline can be expected to reach a maximum at $x = 0$ but must, under any physically realistic representation, be finite at that point.

A8.5.14 From the perspective of model development, there appears to be a problem associated with the nature of the reporting of accident locations. Where the historical accident locations were close to the runway extended centreline, it appears that they were often reported as being exactly on the centreline (i.e. at $x = 0$) whilst in practice they will have been displaced some distance laterally from it. The reported accident locations will therefore be over-concentrated at the centreline and, in order to fit these reported locations closely, a function such as the Weibull distribution that tends to infinity at $x = 0$ is required. The model based on these reported crash locations and associated Weibull pdfs can therefore be expected to over-estimate the crash risks along and close to the runway extended centreline. There will be a corresponding under-estimation of the crash risks across the immediately adjacent region slightly further from the runway centreline. Further still from the runway centreline the use of the Weibull distribution can be expected to provide an effective and realistic fit to the true accident location distributions.

A8.5.15 Studies of aircraft track keeping during normal operations provide a reference point for assessing the potential impact on the reliability of the predictions of the model that employs these physically unrealistic Weibull distributions. The observed tracks follow physically realistic distributions, broadly in accordance with the normal distribution function, that are finite at $x = 0$. Given the nature of the functions employed in the DfT model, there is inevitably a region across which the crash risk is more concentrated than the distribution of aircraft in flight. In effect, aircraft are predicted to crash more accurately along the runway extended centreline than they can fly.

A8.5.16 This somewhat unrealistic scenario is found to apply over a relatively limited distance from the extended centreline only. In order to determine the crash risk, account is taken of the area on the ground that is expected to be destroyed in the event of an accident, in accordance with the crash consequence model assessed further in Section A8.2.6. The values for the predicted “destruction area” for the fleet mixes under the relevant scenarios are of the order of 0.4 hectares. According to the standard approach adopted in the UK DfT model for the determination of individual risk, this destruction area is represented by a simple rectangle of around 63 m by 63 m. The risk at any single location is determined by sum of the probabilities of impact within this area. The integration of the risk over this sort of distance is expected to smooth out the effects associated with this aspect of the model, combining the areas of over-estimation of risk closer to the centreline with immediately adjacent where risk will be correspondingly under-estimated, to some extent at least. The approach adopted for societal risk estimation also involves an element of integration that will smooth out these effects. Overall, it is

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concluded that, whilst there may be an element of over-estimation of risk close to the runway extended centreline, this limitation of the model and reported accident location data upon which it is based is unlikely to have any significant impact on the reliability of the risk predictions of the model.

Treatment of overruns

A8.5.17 The DfT model employs the landing threshold as the basic reference point for landing accident locations. In the case of impacts from flight, the pdf describing the accident location distribution is based on the impact location. This approach is considered to be entirely appropriate. For landing overruns, the pdf describing the accident location distribution is based on the final resting location of the wreckage. There are two fundamental concerns regarding this modelling approach.

A8.5.18 The first key point to note in this respect is that landing operations are matched to the available runway length. Aircraft will land at a given runway only where they are capable of stopping, under normal circumstances and with an appropriate margin of safety, in the landing distance available, taking account of the performance characteristics of the aircraft, its weight and relevant external parameters (wind velocity, runway surface condition). In a small proportion of cases, aircraft are unable to complete the landing manoeuvre in the nominal distance required and overrun beyond the distance in which it was intended that the landing be completed.

A8.5.19 Other studies [6,7] have developed overrun models referenced against the end of the available landing runway and this approach is considered to be more appropriate than the use of landing threshold. The DfT model landing overrun dataset includes a significant number of overruns that come to rest 3,000 m or more from the landing threshold. The vast majority of these will have involved large and heavy aircraft landing on runways of around 3,000 m or more in length and typically overrunning beyond the end of the landing distance available by no more than a few tens of metres. The DfT overrun risk model is therefore not representative of landings at shorter runways. The landing distances available (LDA) at the runways at Dublin are as follows:

- Runway 10R/28L: 2,637 m;
- Runway 10L: 2,830 m;
- Runway 28R: 2,660 m;
- Runway 16/34: 2,072 m.

A8.5.20 Conceptually the DfT model is physically unrealistic and will therefore tend to over-estimate the landing overrun risk, in particular at shorter runways.

A8.5.21 The second concern is that the DfT overrun model employs accident location data without any consideration of the influence of the obstacle environment. Conceptually, this approach may be reasonably appropriate for crashes from flight but is flawed in the case of the overrun. What is observed during overrun events is dependent upon the obstacle environment and may be characterised by two primary outcomes:

- The aircraft decelerates in the open space beyond the runway end and comes to a halt before hitting any obstacle;
- The aircraft fails to stop in the available open space beyond the runway and is arrested by the first substantial obstacle it meets.

A8.5.22 Only those accidents involving a total hull loss that will fall into the second category are employed in the DfT model whilst other studies [6,7] clearly demonstrate that overrun events that do not result in major damage are common. This modelling approach is not representative of the risk scenario concerned.

A8.5.23 A preliminary assessment of the contribution of the overrun risk to the overall risk estimate was undertaken for the western end of the existing south runway, based on a now superseded but still representative movement forecasts, and the findings are illustrated in Figure A8.1. It is evident from this figure that overrun risk makes a very noticeable contribution to the 1 in 100,000 per annum risk contour but not to the 1 in a million risk contour.

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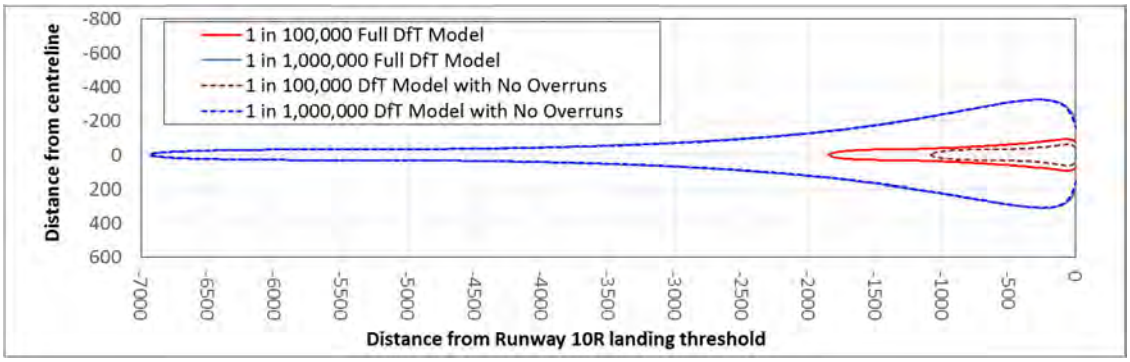
Figure A8.1: Comparison of risk contours with and without overruns



A8.5.24 The large contribution to the 1 in 100,000 per annum risk contour can be seen to be unrealistic on the following basis. The 1 in 100,000 per annum risk contour without overruns extends to a distance of 1,085 m to the west of the Runway 10R landing threshold. The contour with overruns extends to a distance of 1,850 m to the west of the Runway 10R landing threshold. The available take-off overrun dataset [7] of 63 accidents and incidents identifies the longest distance travelled from the runway end as 533 m. For the landing overrun dataset of 239 accidents and incidents, the longest distance travelled from the runway end is 1,160 m and the second longest distance travelled is 624 m. In summary, out of a total of over 300 overrun accidents and incidents, just one travelled further than the 1,085 m distance to which the "no overruns" 1 in 100,000 per annum risk contour extends. That event stopped 690 m short of the limit of the "with overruns" 1 in 100,000 per annum risk contour. The DfT overrun model is evidently predicting a noticeable contribution to the estimated risk at distances that are further from the runway end than any overrun event in the historical accident dataset. The risks predicted in this region can therefore be seen to be significant over-estimates. For the 1 in a million per annum risk contour that extends considerably further from the runway end, there is essentially no noticeable difference between the two contours predicted with and without the inclusion of the overrun model (c. 1 m difference in a contour length of 6,936 m).

A8.5.25 For consistency with the previous recommendations in respect of PSZ policy in the Republic of Ireland, the standard UK DfT model, including overruns, has been employed for estimation of the risk contours but it is noted, on the basis of this analysis, that these will be over-estimates, in particular in respect of the locations closer to the runway ends where the 1 in 100,000 per annum contours are located. The UK DfT overrun model has not been employed in the determination of the societal risk estimates.

Coordinate system origin for take-off accidents

A8.5.26 The UK DfT model essentially employs the end of the declared runway as the reference point for the pdfs that describe take-off accident locations. However, the available description of the model development [1] states that the take-off accident locations are referenced against the threshold nearest the take-off end of runway. That is understood to mean that the nearest landing threshold to the departure end of runway was employed as the reference point when determining the crash locations that were used to develop the take-off accident pdfs. This reference point for take-off accidents is less unambiguous than the threshold is as a reference point for landing accidents.

A8.5.27 In some cases, there may be a displaced threshold and the chosen reference point may therefore not correspond with a specific take-off-related reference point. In some cases, clearway will be available such that take-off distance available from an operational perspective will not correspond with the paved surface. Finally, it may be noted that different aircraft have different inherent take-off distance requirements and the runway length provision in relation to those requirements will vary between different airports. Two crashes with identical operational characteristics may therefore be identified as being located at different distances from the runway end, if they were to occur at runways of different lengths. As a result, there is no clear cut reference point for use in relation to take-off accidents.

A8.5.28 When using the departure end of runway as a reference and pdfs of the type employed in the UK DfT model, a potential problem arises in relation to accidents that occur before that reference point has been reached. It is evident that there can be no crashes during take-off that occur at locations prior to the start of take-off run. This physical reality of the process is not accommodated by the model. The crash

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probability is not constrained to zero at locations before the start of take-off run but varies according to the pdfs selected to fit the data points before the departure end of runway: i.e. the model places a component of take-off risk behind the point at which the take-off run commences. This component of take-off risk should be accounted for somewhere by the modelling process but in a different location. In practice, this misplaced component of the risk can be expected to be relatively small and not to have a major impact on the locations of the estimated risk contours.

A8.5.29 Overall, whilst recognising these uncertainties and the possible benefits associated with using the alternative reference of the start of take-off run, the view adopted is that the departure end of runway represents a convenient and pragmatic coordinate system origin for the current purposes and the DfT modelling approach has been followed in this respect. In the case of Dublin Airport, the Departure End of Runway (DERs) are displaced from the nearest runway thresholds. The manner in which these displacements have been accounted for in the runway geometry employed in model implementation is described in Section A8.2.5.

Runway-aligned departure routes

A8.5.30 The DfT model is based on an assumption that flight paths are runway-aligned whilst some other models [8,9,10] take account of flight paths that deviate from runway alignment. Approach and landing operations are typically runway-aligned for a considerable distance before the landing threshold. In the case of operations at Dublin Airport, approaches to Runway 10 are runway-aligned prior to the final approach fix at 8.5 Nm from the runway (15.7 km) and approaches to Runway 28 are runway-aligned prior to the final approach fix at 7.1 Nm from the runway (13.1 km). The majority of accidents take place closer to the runway and the assumption that approach paths are runway-aligned is reasonable. As described in Section A8.3, the 1 in 1,000,000 per annum risk contours do not extend as far as those distances from the runway threshold.

A8.5.31 In the case of departures, turns are often initiated somewhat closer to the runway ends. For the future operation of the parallel runway system at Dublin, departures from the south runway are runway-aligned out to comparable distances. However, for the north runway, a turn to the north will be initiated shortly after take-off at 0.89 Nm from the runway end, after which aircraft may adopt a range of potential pathways at different angles offset from the runway axis. These flight paths will be runway-aligned over a limited region closer to the runway but not throughout the area of interest. Further detail concerning these offset flight paths are provided in Section A8.2.8.

A8.5.32 The description of the DfT model development states the following in relation to departure routes:

4.25 No attempt to 'bend' the distributions around the arrival and departure routes was made for this model and all crash locations were measured relative to the runway ends and the extended runway centreline. The reason for this decision was that only a small proportion of crash reports record in detail the intended route of the aircraft prior to an accident. Even when this is recorded it is not always clear how to relate the intended route of the aircraft to the eventual accident location. For example, on departure a serious problem (which ultimately causes a crash) may arise before the intended route deviates from a straight path. In this case, the pilot would not attempt to follow the intended curved route, and therefore the actual crash location would be the same irrespective of whether the intended route was curved or straight.

4.26 The fact that aircraft do not always follow straight routes will to some extent be implicit in the NATS model [i.e. the UK DfT model], as some of the historical crashes would have occurred while aircraft were on curved routes. Thus the 'average' effect of aircraft routeing on crash location is taken into account in the NATS model. The effects of curved routes are likely to be small, where the risk is greatest, close to the runway ends.

A8.5.33 Whilst the comments relating to the quality of the information concerning the intended route in para. 4.25 may be true, that does not validate the approach adopted in the DfT model. Some of the crash locations may relate to specific flight paths at certain airports that are not runway-aligned. The use of these locations in a runway-aligned model may lead to a greater degree of dispersion being predicted than would arise in practice for runway-aligned routes. The observation in para 4.26 that the "average" effect of aircraft routeing on crash location is taken into account is not helpful in this respect since the accurate prediction of areas of higher crash probability at any individual airport will be dependent on the specific details of routeing at that airport and not on the average. The observation that the effects of curved

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routes are likely to be small, where the risk is greatest, close to the runway, would appear to be reasonable. For the implementation of UK PSZ policy which makes reference to the 1 in 100,000 per annum risk contours which are typically located relatively close to runway ends, this modelling approach is adequate.

A8.5.34 However, for the purposes of this assessment, consideration is being given to crash risks across a wider area that extends further from the runway ends and where these effects may be more substantial. In that context, a modified approach has been employed in this assessment in which the risks at any given point relative to the flight paths were determined on the basis of the identified distribution functions where the y value (distance from the threshold) is measured along the line of the curved flight path and the x value (displacement from the flight path) is measured perpendicular to the tangent of the curve of flight path at the appropriate y value. Accordingly, the distribution functions are bent around the flight paths in use in a manner consistent with that employed in the NLR model [9]. In practice, as is evident from the predicted contours shown in the EIAR, whether straight or curved departure routes are employed makes no significant difference to the predicted risks. Whilst the effect of the use of curved departure routes is evident in the 1 in a million per annum risk contours, the areas subject to differences due to these assumptions are predominantly free from development. The more refined modelling approach may relocate areas subject to higher probability of air crash but only slightly. However, since these areas are predominantly unpopulated, the risks to people on the ground will be very similar to that using the simpler assumption of runway-aligned flight paths.

A8.5.3 Accident consequence model

A8.5.35 The DfT consequence model is based on the empirical relationship between the area destroyed and the size of the aircraft, characterised in terms of the maximum take-off weight allowed (MTWA), as determined by reference to the historical accident record. The original DfT consequence model identified the following logarithmic relationship:

$\log_e(\text{Area destroyed}) = -6.36 + 0.49 \log_e(\text{MTWA})$

This relationship was subsequently revised slightly as follows:

$\log_e(\text{Area destroyed}) = -6.16 + 0.474 \log_e(\text{MTWA})$

A8.5.36 The historical accident record indicates a clear dependence of the size of the area affected in the event of a ground impact on aircraft size. The identified logarithmic relationship lacks an element of physical realism in that it does not provide for the prediction of an area destroyed of zero for a weight of zero. However, it is found to provide a better fit to the available empirical data across the range of aircraft sizes encountered in practice.

A8.5.37 Theoretical considerations based on dimensional analysis suggest that a linear dependence is not to be expected. For simplicity, consideration is given to a simple rectilinear object of length, l, width, w and height, h. The volume will be given by $V = l \times w \times h$. Volume is proportional to mass: $V \propto M$. On impact with a surface, a constant force for deceleration per unit area over which the impact takes place is assumed. The contact area will be proportional to the square of the linear dimension. For an object sliding across a surface the contact area will be $l \times w$ and for impact with a wall, the contact area will be $w \times h$. On that basis the contact area will be proportional to Mass to the power 2/3. The kinetic energy to be dissipated will be directly proportional to mass. Accordingly, the distance travelled to arrest the Mass due to the identified deceleration force will be proportional to Mass to the power 1/3. Assuming that the consequence area is given by the object width multiplied by the distance travelled it would therefore be expected to be proportional to mass to the power 2/3.

A8.5.38 The above dimensional analysis based on a rectilinear object may not be entirely representative of aircraft behaviour in the event of an accident but it does provide some theoretical basis for the identification of the nature of the relationship between aircraft size and the scale of the impact consequences. The UK DfT logarithmic model is found to agree fairly well with the Mass to the power 2/3 relationship, although, empirically, a square root relationship appears to provide a better basis for correlation with the identified logarithmic relationship. The available accident dataset includes a limited number of accidents involving larger aircraft and there is therefore some uncertainty as to whether the observed empirical logarithmic relationship provides a sound basis for predicting crash consequences for larger aircraft. The theoretical Mass to the power 2/3 relationship would indicate somewhat larger

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areas destroyed for larger aircraft than the empirical logarithmic relationship of the UK DfT model. However, larger aircraft for which limited empirical crash consequence data is available (i.e. those of around 200 tonnes or more) make up a relatively small proportion of the operations (around 10%). The estimated risks will be dominated by the contribution made by smaller aircraft for which the empirical logarithmic model is expected to provide reliable crash consequence estimates. Overall, it is concluded that the logarithmic UK DfT crash consequence model is an appropriate model for use in the current assessment.

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Annex 1: Geometric Specifications for Modelled Departure Routes

Route	Turn 1 centre (local x)	Turn 1 centre (local y)	Turn 1 direction (C/AC)	Turn 1 radius (m)	Turn 1 angle (°)	Turn 2 centre (local x)	Turn 2 centre (local y)	Turn 2 direction (C/AC)	Turn 2 radius (m)	Turn 2 angle (°)
N28R_D_AB_ROTEV	2000	-500	C	2000	132	5288	3152	AC	2914	46
N28R-I_D_CD_ABB-E	4000	1700	C	4000	178	-	-	-	-	-
N28R-I_D_CD_ABBEY	3304	2185	C	3304	75	5742	2186	C	3994	106
N28R_D_CD_NEPOD	2037	2185	C	2037	30	-439	10006	AC	3994	137
N28R-I_D_CD_NEP-E	2037	2185	C	2037	30	-2484	6578	AC	4051	125
N28R_D_CD_NEP-M	2037	2185	C	2037	30	-1426	8242	AC	3967	131
N10L_D_CD_ABBEY	-757	1963	AC	757	15	-4967	7927	AC	3265	5
N10L_D_AB_ROTEV	-1984	-500	AC	1984	110	-7267	3853	C	3914	40
S10_D_AB-LIFFY	-2698	-900	AC	2698	58.2	-6886	7688	C	2396	54.8
S10_D_AB-NEPOD	2351	-700	C	2351	67.2	-	-	-	-	-
S10_D_CD-NEPOD	4108	12000	C	4108	93.3	-	-	-	-	-
S10_D_CD-LIFFY	-9419	9500	AC	9419	14.7	-	-	-	-	-
S28_D_AB-LIFFY	1961	-500	C	1961	88.5	6462	-471	C	2068	88.1
S28_D_AB-NEPOD	-1962	-500	AC	1962	118.3	-	-	-	-	-
S28_D_CD-LIF-E	3979	5000	C	3979	176.3	-	-	-	-	-
S28_D_CD-LIF-M	3979	6800	C	3979	176.3	-	-	-	-	-
S28_D_CD-ROTEV	4005	8800	C	4005	108.3	-	-	-	-	-
S28_D_CD-NEP-E	-3981	4900	AC	3981	114.8	-	-	-	-	-
S28_D_CD-NEP-M	-3983	6700	AC	3983	116.6	-	-	-	-	-
S28_D_CD-NEPOD	-3988	8800	AC	3988	118.7	-	-	-	-	-

Document Classification: Class 1 - General

Annex 2: Fleet Mixes

2022 Permitted Operations Fleet Mix

Aircraft Type	10L Arrivals	28R Arrivals	10R Arrivals	28L Arrivals	16 Arrivals	34 Arrivals
Airbus A306	0	0	0	0	0	0
Airbus A318	87	0	0	210	2	1
Airbus A319	261	0	0	631	7	2
Airbus A320	4966	0	436	13039	140	47
Airbus A320neo	349	0	0	841	9	3
Airbus A321	610	0	174	1893	20	7
Airbus A321neo	261	0	87	841	9	3
Airbus A330	1307	0	87	3365	36	12
ATR 42	349	0	0	841	9	3
ATR 72	2440	0	87	6099	65	22
Boeing 737 MAX	523	0	0	1262	14	5
Boeing 737-400	87	0	174	631	7	2
Boeing 737-800	8016	0	784	21241	228	76
Boeing 767	87	0	174	631	7	2
Boeing 777	87	0	87	421	5	2
Boeing 787	610	0	87	1682	18	6
Bombardier CS300	174	0	0	421	5	2
Bombardier Dash 8	261	0	0	631	7	2
Cessna 441	87	0	0	210	2	1
Embraer 145	87	0	0	210	2	1
Embraer 170	87	0	0	210	2	1
Embraer E190/195	1133	0	0	2734	29	10

Document Classification: Class 1 - General

2022 Permitted Operations Fleet Mix Continued

Aircraft Type	*16 Dep*	*34 Dep*	*N10L Dep CD_ABBEY*	*N10L-I Dep AB_ROTEV*	*N28R-I Dep AB_ROTEV*	*N28R Dep CD_ABB-E*
Airbus A306	2	1	0	0	0	140
Airbus A318	2	1	0	0	0	0
Airbus A319	7	2	0	0	0	280
Airbus A320	137	46	0	0	0	3785
Airbus A320neo	9	3	0	0	0	280
Airbus A321	20	7	0	0	0	841
Airbus A321neo	9	3	0	0	0	140
Airbus A330	36	12	0	0	0	0
ATR 42	9	3	0	349	841	0
ATR 72	65	22	0	1743	4206	0
Boeing 737 MAX	14	5	0	0	0	841
Boeing 737-400	7	2	0	0	0	140
Boeing 737-800	228	76	0	0	0	7150
Boeing 767	7	2	0	0	0	140
Boeing 777	5	2	0	0	0	140
Boeing 787	18	6	0	0	0	140
Bombardier CS300	5	2	0	0	0	140
Bombardier Dash 8	7	2	0	0	0	0
Cessna 441	2	1	0	87	210	0
Embraer 145	2	1	0	0	0	140
Embraer 170	2	1	0	0	0	0
Embraer E190/195	29	10	0	0	0	561

Document Classification: Class 1 - General

2022 Permitted Operations Fleet Mix Continued

Aircraft Type	N28R Dep CD_ABBEY	N28R Dep CD_NEPOD	N28R Dep CD_NEP-E	N28R Dep CD_NEP-M	S10R Dep AB_LIFFY	S10R Dep AB_NEPOD
Airbus A306	70	0	0	0	0	0
Airbus A318	0	70	70	70	0	0
Airbus A319	140	70	70	70	0	0
Airbus A320	1893	1682	1682	1682	0	0
Airbus A320neo	140	140	140	140	0	0
Airbus A321	421	210	210	210	0	0
Airbus A321neo	70	421	0	0	0	0
Airbus A330	841	2383	70	70	0	0
ATR 42	0	0	0	0	0	0
ATR 72	0	0	0	0	87	697
Boeing 737 MAX	421	0	0	0	0	0
Boeing 737-400	70	0	0	0	0	0
Boeing 737-800	3575	2944	2944	2944	0	0
Boeing 767	70	70	70	70	0	0
Boeing 777	70	210	0	0	0	0
Boeing 787	701	491	70	70	0	0
Bombardier CS300	70	70	70	70	0	0
Bombardier Dash 8	0	0	0	0	0	261
Cessna 441	0	0	0	0	0	0
Embraer 145	70	0	0	0	0	0
Embraer 170	0	70	70	70	0	0
Embraer E190/195	280	491	491	491	0	0

Document Classification: Class 1 - General

2022 Permitted Operations Fleet Mix Continued

Aircraft Type	S10R Dep CD_NEPOD	S10R Dep CD_LIFFY	S28L Dep AB_LIFFY	S28L Dep AB_NEPOD	S28L Dep CD_ROTEV	S28L Dep CD_LIFF-E
Airbus A306	0	87	0	0	0	0
Airbus A318	87	0	0	0	0	0
Airbus A319	87	174	0	0	0	0
Airbus A320	2440	2875	0	0	421	421
Airbus A320neo	174	174	0	0	0	0
Airbus A321	261	523	0	0	0	0
Airbus A321neo	0	349	0	0	70	70
Airbus A330	174	1220	0	0	0	0
ATR 42	0	0	0	0	0	0
ATR 72	0	0	210	1682	0	0
Boeing 737 MAX	0	523	0	0	0	0
Boeing 737-400	87	174	0	0	210	0
Boeing 737-800	4269	4531	0	0	70	70
Boeing 767	174	87	0	0	0	0
Boeing 777	0	174	0	0	0	0
Boeing 787	87	610	0	0	210	0
Bombardier CS300	87	87	0	0	0	0
Bombardier Dash 8	0	0	0	631	0	0
Cessna 441	0	0	0	0	0	0
Embraer 145	0	87	0	0	0	0
Embraer 170	87	0	0	0	0	0
Embraer E190/195	697	436	0	0	70	70

Document Classification: Class 1 - General

2022 Permitted Operations Fleet Mix Continued

Aircraft Type	S28L Dep CD_LIFF-M	S28L Dep CD_NEPOD	S28L Dep CD_NEP-E	S28L Dep CD_NEP-M
Airbus A306	0	0	0	0
Airbus A318	0	0	0	0
Airbus A319	0	0	0	0
Airbus A320	421	280	280	280
Airbus A320neo	0	0	0	0
Airbus A321	0	0	0	0
Airbus A321neo	70	0	0	0
Airbus A330	0	0	0	0
ATR 42	0	0	0	0
ATR 72	0	0	0	0
Boeing 737 MAX	0	0	0	0
Boeing 737-400	0	210	0	0
Boeing 737-800	70	491	491	491
Boeing 767	0	210	0	0
Boeing 777	0	0	0	0
Boeing 787	0	0	0	0
Bombardier CS300	0	0	0	0
Bombardier Dash 8	0	0	0	0
Cessna 441	0	0	0	0
Embraer 145	0	0	0	0
Embraer 170	0	0	0	0
Embraer E190/195	70	70	70	70

Document Classification: Class 1 - General

2022 Proposed Operations Fleet Mix

Aircraft Type	10L Arrivals	28R Arrivals	10R Arrivals	28L Arrivals	16 Arrivals	34 Arrivals
Airbus A306	0	0	0	0	0	0
Airbus A318	87	0	0	210	2	1
Airbus A319	261	0	0	631	7	2
Airbus A320	5314	0	523	14089	151	50
Airbus A320neo	348	0	0	841	9	3
Airbus A321	871	0	87	2313	25	8
Airbus A321neo	174	0	174	841	9	3
Airbus A330	958	0	436	3365	36	12
ATR 42	348	0	0	841	9	3
ATR 72	2439	0	87	6098	65	22
Boeing 737 MAX	523	0	0	1262	14	5
Boeing 737-400	87	0	174	631	7	2
Boeing 737-800	8886	0	697	23131	248	83
Boeing 767	87	0	174	631	7	2
Boeing 777	87	0	87	421	5	2
Boeing 787	610	0	87	1682	18	6
Bombardier CS300	174	0	0	421	5	2
Bombardier Dash 8	261	0	0	631	7	2
Cessna 441	87	0	0	210	2	1
Embraer 145	87	0	0	210	2	1
Embraer 170	87	0	0	210	2	1
Embraer E190/195	1133	0	0	2734	29	10

Document Classification: Class 1 - General

2022 Proposed Operations Fleet Mix Continued

Aircraft Type	16 Dep	34 Dep	N10L Dep CD_ABBEY	N10L-I Dep AB_ROTEV	N28R-I Dep AB_ROTEV	N28R Dep CD_ABB-E
Airbus A306	2	1	0	0	0	140
Airbus A318	2	1	0	0	0	0
Airbus A319	7	2	0	0	0	280
Airbus A320	151	50	0	0	0	4486
Airbus A320neo	9	3	0	0	0	280
Airbus A321	25	8	0	0	0	841
Airbus A321neo	9	3	0	0	0	280
Airbus A330	36	12	0	0	0	0
ATR 42	9	3	0	348	841	0
ATR 72	65	22	0	1742	4206	0
Boeing 737 MAX	14	5	0	0	0	841
Boeing 737-400	7	2	0	0	0	140
Boeing 737-800	248	83	0	0	0	7851
Boeing 767	7	2	0	0	0	140
Boeing 777	5	2	0	0	0	140
Boeing 787	18	6	0	0	0	140
Bombardier CS300	5	2	0	0	0	140
Bombardier Dash 8	7	2	0	0	0	0
Cessna 441	2	1	0	87	210	0
Embraer 145	2	1	0	0	0	140
Embraer 170	2	1	0	0	0	0
Embraer E190/195	29	10	0	0	0	701

Document Classification: Class 1 - General

2022 Proposed Operations Fleet Mix Continued

Aircraft Type	N28R Dep CD_ABBEY	N28R Dep CD_NEPOD	N28R Dep CD_NEP-E	N28R Dep CD_NEP-M	S10R Dep AB_LIFFY	S10R Dep AB_NEPOD
Airbus A306	70	0	0	0	0	0
Airbus A318	0	70	70	70	0	0
Airbus A319	140	70	70	70	0	0
Airbus A320	2243	2313	2313	2313	0	0
Airbus A320neo	140	140	140	140	0	0
Airbus A321	421	350	350	350	0	0
Airbus A321neo	140	421	0	0	0	0
Airbus A330	841	2383	70	70	0	0
ATR 42	0	0	0	0	0	0
ATR 72	0	0	0	0	87	697
Boeing 737 MAX	421	0	0	0	0	0
Boeing 737-400	280	0	0	0	0	0
Boeing 737-800	3925	3785	3785	3785	0	0
Boeing 767	70	70	70	70	0	0
Boeing 777	70	210	0	0	0	0
Boeing 787	701	491	70	70	0	0
Bombardier CS300	70	70	70	70	0	0
Bombardier Dash 8	0	0	0	0	0	261
Cessna 441	0	0	0	0	0	0
Embraer 145	70	0	0	0	0	0
Embraer 170	0	70	70	70	0	0
Embraer E190/195	350	561	561	561	0	0

Document Classification: Class 1 - General

2022 Proposed Operations Fleet Mix Continued

Aircraft Type	S10R Dep CD_NEPOD	S10R Dep CD_LIFFY	S28L Dep AB_LIFFY	S28L Dep AB_NEPOD	S28L Dep CD_ROTEV	S28L Dep CD_LIFF-E
Airbus A306	0	87	0	0	0	0
Airbus A318	87	0	0	0	0	0
Airbus A319	87	174	0	0	0	0
Airbus A320	2875	2962	0	0	140	140
Airbus A320neo	174	174	0	0	0	0
Airbus A321	436	523	0	0	0	0
Airbus A321neo	0	348	0	0	0	0
Airbus A330	174	1220	0	0	0	0
ATR 42	0	0	0	0	0	0
ATR 72	0	0	210	1682	0	0
Boeing 737 MAX	0	523	0	0	0	0
Boeing 737-400	87	174	0	0	0	0
Boeing 737-800	4704	4879	0	0	0	0
Boeing 767	174	87	0	0	0	0
Boeing 777	0	174	0	0	0	0
Boeing 787	87	610	0	0	210	0
Bombardier CS300	87	87	0	0	0	0
Bombardier Dash 8	0	0	0	631	0	0
Cessna 441	0	0	0	0	0	0
Embraer 145	0	87	0	0	0	0
Embraer 170	87	0	0	0	0	0
Embraer E190/195	697	436	0	0	0	0

Document Classification: Class 1 - General

2022 Proposed Operations Fleet Mix Continued

Aircraft Type	*S28L Dep CD_LIFF-M*	*S28L Dep CD_NEPOD*	*S28L Dep CD_NEP-E*	*S28L Dep CD_NEP-M*
Airbus A306	0	0	0	0
Airbus A318	0	0	0	0
Airbus A319	0	0	0	0
Airbus A320	140	0	0	0
Airbus A320neo	0	0	0	0
Airbus A321	0	0	0	0
Airbus A321neo	0	0	0	0
Airbus A330	0	0	0	0
ATR 42	0	0	0	0
ATR 72	0	0	0	0
Boeing 737 MAX	0	0	0	0
Boeing 737-400	0	210	0	0
Boeing 737-800	0	0	0	0
Boeing 767	0	210	0	0
Boeing 777	0	0	0	0
Boeing 787	0	0	0	0
Bombardier CS300	0	0	0	0
Bombardier Dash 8	0	0	0	0
Cessna 441	0	0	0	0
Embraer 145	0	0	0	0
Embraer 170	0	0	0	0
Embraer E190/195	0	0	0	0

Document Classification: Class 1 - General

2025 Permitted Operations Fleet Mix

Aircraft Type	10L Arrivals	28R Arrivals	10R Arrivals	28L Arrivals	16 Arrivals	34 Arrivals
Airbus A318	94	0	0	228	2	1
Airbus A319	94	0	0	228	2	1
Airbus A320	6322	0	566	16626	178	59
Airbus A320neo	2170	0	94	5466	59	20
Airbus A321	94	0	0	228	2	1
Airbus A321neo	755	0	283	2505	27	9
Airbus A330	1510	0	189	4099	44	15
Airbus A330neo	377	0	0	911	10	3
Airbus A350	94	0	0	228	2	1
ATR 42	377	0	0	911	10	3
ATR 72	2642	0	94	6605	71	24
Boeing 737 MAX	2264	0	0	5466	59	20
Boeing 737-400	0	0	94	228	2	1
Boeing 737-700	94	0	0	228	2	1
Boeing 737-800	9247	0	1227	25280	271	90
Boeing 767	94	0	189	683	7	2
Boeing 777	0	0	94	228	2	1
Boeing 777X	189	0	0	455	5	2
Boeing 787	944	0	94	2505	27	9
Bombardier CS300	189	0	0	455	5	2
Bombardier Dash 8	472	0	0	1139	12	4
Cessna 441	94	0	0	228	2	1
Embraer 145	94	0	0	228	2	1
Embraer 170	283	0	0	683	7	2
Embraer E190/195	1415	0	0	3416	37	12

Document Classification: Class 1 - General

2025 Permitted Operations Fleet Mix Continued

Aircraft Type	16 Dep	34 Dep	N10L Dep CD_ABBEY	N10L-I Dep AB_ROTEV	N28R-I Dep AB_ROTEV	N28R Dep CD_ABB-E
Airbus A318	2	1	0	0	0	0
Airbus A319	2	1	0	0	0	152
Airbus A320	178	59	0	0	0	5010
Airbus A320neo	59	20	0	0	0	1670
Airbus A321	2	1	0	0	0	152
Airbus A321neo	27	9	0	0	0	759
Airbus A330	46	15	0	0	0	152
Airbus A330neo	10	3	0	0	0	0
Airbus A350	2	1	0	0	0	152
ATR 42	10	3	0	377	911	0
ATR 72	71	24	0	1887	4555	0
Boeing 737 MAX	59	20	0	0	0	3340
Boeing 737-400	2	1	0	0	0	0
Boeing 737-700	2	1	0	0	0	152
Boeing 737-800	271	90	0	0	0	8047
Boeing 767	7	2	0	0	0	152
Boeing 777	2	1	0	0	0	0
Boeing 777X	5	2	0	0	0	304
Boeing 787	27	9	0	0	0	304
Bombardier CS300	5	2	0	0	0	152
Bombardier Dash 8	12	4	0	94	228	0
Cessna 441	2	1	0	94	228	0
Embraer 145	2	1	0	0	0	152
Embraer 170	7	2	0	0	0	0
Embraer E190/195	37	12	0	0	0	911

Document Classification: Class 1 - General

2025 Permitted Operations Fleet Mix Continued

Aircraft Type	N28R Dep CD_ABBEY	N28R Dep CD_NEPOD	N28R Dep CD_NEP-E	N28R Dep CD_NEP-M	S10R Dep AB_LIFFY	S10R Dep AB_NEPOD
Airbus A318	0	76	76	76	0	0
Airbus A319	76	0	0	0	0	0
Airbus A320	2505	1898	1898	1898	0	0
Airbus A320neo	835	759	759	759	0	0
Airbus A321	76	0	0	0	0	0
Airbus A321neo	380	607	152	152	0	0
Airbus A330	759	2961	0	0	0	0
Airbus A330neo	455	455	0	0	0	0
Airbus A350	76	0	0	0	0	0
ATR 42	0	0	0	0	0	0
ATR 72	0	0	0	0	94	755
Boeing 737 MAX	1670	152	152	152	0	0
Boeing 737-400	0	0	0	0	0	0
Boeing 737-700	76	0	0	0	0	0
Boeing 737-800	4024	2961	2961	2961	0	0
Boeing 767	76	76	76	76	0	0
Boeing 777	0	228	0	0	0	0
Boeing 777X	152	0	0	0	0	0
Boeing 787	835	987	76	76	0	0
Bombardier CS300	76	0	0	0	0	0
Bombardier Dash 8	0	0	0	0	0	377
Cessna 441	0	0	0	0	0	0
Embraer 145	76	0	0	0	0	0
Embraer 170	0	228	228	228	0	0
Embraer E190/195	455	304	304	304	0	0

Document Classification: Class 1 - General

2025 Permitted Operations Fleet Mix Continued

Aircraft Type	S10R Dep CD_NEPOD	S10R Dep CD_LIFFY	S28L Dep AB_LIFFY	S28L Dep AB_NEPOD	S28L Dep CD_ROTEV	S28L Dep CD_LIFF-E
Airbus A318	94	0	0	0	0	0
Airbus A319	0	94	0	0	0	0
Airbus A320	3208	3680	0	0	455	455
Airbus A320neo	1038	1227	0	0	152	152
Airbus A321	0	94	0	0	0	0
Airbus A321neo	283	755	0	0	76	76
Airbus A330	189	1604	0	0	0	0
Airbus A330neo	94	283	0	0	0	0
Airbus A350	0	94	0	0	0	0
ATR 42	0	0	0	0	0	0
ATR 72	0	0	228	1822	0	0
Boeing 737 MAX	189	2076	0	0	0	0
Boeing 737-400	94	0	0	0	0	0
Boeing 737-700	0	94	0	0	0	0
Boeing 737-800	5284	5189	0	0	304	76
Boeing 767	189	94	0	0	0	0
Boeing 777	0	94	0	0	0	0
Boeing 777X	0	189	0	0	0	0
Boeing 787	94	944	0	0	228	0
Bombardier CS300	94	94	0	0	0	0
Bombardier Dash 8	0	0	0	911	0	0
Cessna 441	0	0	0	0	0	0
Embraer 145	0	94	0	0	0	0
Embraer 170	283	0	0	0	0	0
Embraer E190/195	755	660	0	0	76	76

Document Classification: Class 1 - General

2025 Permitted Operations Fleet Mix Continued

Aircraft Type	S28L Dep CD_LIFF-M	S28L Dep CD_NEPOD	S28L Dep CD_NEP-E	S28L Dep CD_NEP-M
Airbus A318	0	0	0	0
Airbus A319	0	0	0	0
Airbus A320	455	683	683	683
Airbus A320neo	152	76	76	76
Airbus A321	0	0	0	0
Airbus A321neo	76	76	76	76
Airbus A330	0	152	152	152
Airbus A330neo	0	0	0	0
Airbus A350	0	0	0	0
ATR 42	0	0	0	0
ATR 72	0	0	0	0
Boeing 737 MAX	0	0	0	0
Boeing 737-400	0	228	0	0
Boeing 737-700	0	0	0	0
Boeing 737-800	76	1291	1291	1291
Boeing 767	0	228	0	0
Boeing 777	0	0	0	0
Boeing 777X	0	0	0	0
Boeing 787	0	0	0	0
Bombardier CS300	0	76	76	76
Bombardier Dash 8	0	0	0	0
Cessna 441	0	0	0	0
Embraer 145	0	0	0	0
Embraer 170	0	0	0	0
Embraer E190/195	76	304	304	304

Document Classification: Class 1 - General

2025 Proposed Operations Fleet Mix

Aircraft Type	10L Arrivals	28R Arrivals	10R Arrivals	28L Arrivals	16 Arrivals	34 Arrivals
Airbus A318	94	0	0	228	2	1
Airbus A319	94	0	0	228	2	1
Airbus A320	6510	0	755	17537	188	63
Airbus A320neo	2170	0	94	5466	59	20
Airbus A321	94	0	0	228	2	1
Airbus A321neo	944	0	283	2961	32	11
Airbus A330	1227	0	472	4099	44	15
Airbus A330neo	283	0	94	911	10	3
Airbus A350	94	0	0	228	2	1
ATR 42	377	0	0	911	10	3
ATR 72	2642	0	94	6605	71	24
Boeing 737 MAX	2076	0	0	5010	54	18
Boeing 737-400	0	0	94	228	2	1
Boeing 737-700	94	0	0	228	2	1
Boeing 737-800	10379	0	1038	27558	295	98
Boeing 767	94	0	189	683	7	2
Boeing 777	0	0	94	228	2	1
Boeing 777X	189	0	0	455	5	2
Boeing 787	944	0	94	2505	27	9
Bombardier CS300	189	0	0	455	5	2
Bombardier Dash 8	472	0	0	1139	12	4
Cessna 441	94	0	0	228	2	1
Embraer 145	94	0	0	228	2	1
Embraer 170	283	0	0	683	7	2
Embraer E190/195	1415	0	0	3416	37	12

Document Classification: Class 1 - General

2025 Proposed Operations Fleet Mix Continued

Aircraft Type	16 Dep	34 Dep	N10L Dep CD_ABBEY	N10L-I Dep AB_ROTEV	N28R-I Dep AB_ROTEV	N28R Dep CD_ABB-E
Airbus A318	2	1	0	0	0	0
Airbus A319	2	1	0	0	0	152
Airbus A320	188	63	1038	0	0	5618
Airbus A320neo	59	20	283	0	0	1974
Airbus A321	2	1	0	0	0	152
Airbus A321neo	32	11	283	0	0	911
Airbus A330	46	15	0	0	0	152
Airbus A330neo	10	3	0	0	0	0
Airbus A350	2	1	0	0	0	152
ATR 42	10	3	0	377	911	0
ATR 72	71	24	0	1887	4555	0
Boeing 737 MAX	54	18	0	0	0	3037
Boeing 737-400	2	1	0	0	0	0
Boeing 737-700	2	1	0	0	0	152
Boeing 737-800	295	98	1227	0	0	8806
Boeing 767	7	2	0	0	0	152
Boeing 777	2	1	94	0	0	0
Boeing 777X	5	2	0	0	0	304
Boeing 787	27	9	0	0	0	304
Bombardier CS300	5	2	0	0	0	152
Bombardier Dash 8	12	4	0	94	228	0
Cessna 441	2	1	0	94	228	0
Embraer 145	2	1	0	0	0	152
Embraer 170	7	2	0	0	0	0
Embraer E190/195	37	12	94	0	0	1063

Document Classification: Class 1 - General

2025 Proposed Operations Fleet Mix Continued

Aircraft Type	N28R Dep CD_ABBEY	N28R Dep CD_NEPOD	N28R Dep CD_NEP-E	N28R Dep CD_NEP-M	S10R Dep AB_LIFFY	S10R Dep AB_NEPOD
Airbus A318	0	76	76	76	0	0
Airbus A319	76	0	0	0	0	0
Airbus A320	2809	1974	1974	1974	0	0
Airbus A320neo	987	759	759	759	0	0
Airbus A321	76	0	0	0	0	0
Airbus A321neo	455	683	228	228	0	0
Airbus A330	759	2961	0	0	0	0
Airbus A330neo	455	455	0	0	0	0
Airbus A350	76	0	0	0	0	0
ATR 42	0	0	0	0	0	0
ATR 72	0	0	0	0	94	755
Boeing 737 MAX	1518	152	152	152	0	0
Boeing 737-400	0	0	0	0	0	0
Boeing 737-700	76	0	0	0	0	0
Boeing 737-800	4631	3492	3492	3492	0	0
Boeing 767	76	76	76	76	0	0
Boeing 777	0	228	0	0	0	0
Boeing 777X	152	0	0	0	0	0
Boeing 787	835	987	76	76	0	0
Bombardier CS300	76	76	76	76	0	0
Bombardier Dash 8	0	0	0	0	0	377
Cessna 441	0	0	0	0	0	0
Embraer 145	76	0	0	0	0	0
Embraer 170	0	228	228	228	0	0
Embraer E190/195	531	380	380	380	0	0

Document Classification: Class 1 - General

2025 Proposed Operations Fleet Mix Continued

Aircraft Type	S10R Dep CD_NEPOD	S10R Dep CD_LIFFY	S28L Dep AB_LIFFY	S28L Dep AB_NEPOD	S28L Dep CD_ROTEV	S28L Dep CD_LIFF-E
Airbus A318	94	0	0	0	0	0
Airbus A319	0	94	0	0	0	0
Airbus A320	3491	2736	0	0	228	228
Airbus A320neo	1038	944	0	0	0	0
Airbus A321	0	94	0	0	0	0
Airbus A321neo	472	472	0	0	0	0
Airbus A330	189	1604	0	0	0	0
Airbus A330neo	94	283	0	0	0	0
Airbus A350	0	94	0	0	0	0
ATR 42	0	0	0	0	0	0
ATR 72	0	0	228	1822	0	0
Boeing 737 MAX	189	1887	0	0	0	0
Boeing 737-400	94	0	0	0	0	0
Boeing 737-700	0	94	0	0	0	0
Boeing 737-800	5850	4340	0	0	0	0
Boeing 767	189	94	0	0	0	0
Boeing 777	0	0	0	0	0	0
Boeing 777X	0	189	0	0	0	0
Boeing 787	94	944	0	0	228	0
Bombardier CS300	94	94	0	0	0	0
Bombardier Dash 8	0	0	0	911	0	0
Cessna 441	0	0	0	0	0	0
Embraer 145	0	94	0	0	0	0
Embraer 170	283	0	0	0	0	0
Embraer E190/195	755	566	0	0	0	0

Document Classification: Class 1 - General

2025 Proposed Operations Fleet Mix Continued

Aircraft Type	S28L Dep CD_LIFF-M	S28L Dep CD_NEPOD	S28L Dep CD_NEP-E	S28L Dep CD_NEP-M
Airbus A318	0	0	0	0
Airbus A319	0	0	0	0
Airbus A320	228	835	835	835
Airbus A320neo	0	76	76	76
Airbus A321	0	0	0	0
Airbus A321neo	0	152	152	152
Airbus A330	0	152	152	152
Airbus A330neo	0	0	0	0
Airbus A350	0	0	0	0
ATR 42	0	0	0	0
ATR 72	0	0	0	0
Boeing 737 MAX	0	0	0	0
Boeing 737-400	0	228	0	0
Boeing 737-700	0	0	0	0
Boeing 737-800	0	1215	1215	1215
Boeing 767	0	228	0	0
Boeing 777	0	0	0	0
Boeing 777X	0	0	0	0
Boeing 787	0	0	0	0
Bombardier CS300	0	0	0	0
Bombardier Dash 8	0	0	0	0
Cessna 441	0	0	0	0
Embraer 145	0	0	0	0
Embraer 170	0	0	0	0
Embraer E190/195	0	228	228	228

Document Classification: Class 1 - General

2035 Permitted Operations Fleet Mix

Aircraft Type	10L Arrivals	28R Arrivals	10R Arrivals	28L Arrivals	16 Arrivals	34 Arrivals
Airbus A319	94	0	0	228	2	1
Airbus A320	3515	0	71	8654	93	31
Airbus A320neo	5378	0	660	14576	156	52
Airbus A321	94	0	0	228	2	1
Airbus A321neo	1132	0	377	3644	39	13
Airbus A330	778	0	165	2277	24	8
Airbus A330neo	826	0	118	2277	24	8
Airbus A350	71	0	24	228	2	1
ATR 42	377	0	0	911	10	3
ATR 72	2618	0	118	6605	71	24
Boeing 737 MAX	10355	0	1156	27785	298	99
Boeing 737-400	0	0	94	228	2	1
Boeing 737-800	1510	0	189	4099	44	15
Boeing 767	94	0	189	683	7	2
Boeing 777	0	0	94	228	2	1
Boeing 777X	189	0	0	455	5	2
Boeing 787	1038	0	189	2961	32	11
Bombardier CS300	259	0	24	683	7	2
Bombardier Dash 8	448	0	24	1139	12	4
Cessna 441	94	0	0	228	2	1
Embraer 145	94	0	0	228	2	1
Embraer 170	283	0	0	683	7	2
Embraer E190/195	94	0	0	228	2	1
Embraer E190-E2	1321	0	0	3188	34	11

Document Classification: Class 1 - General

2035 Permitted Operations Fleet Mix Continued

Aircraft Type	16 Dep	34 Dep	N10L Dep CD_ABBEY	N10L-I Dep AB_ROTEV	N28R-I Dep AB_ROTEV	N28R Dep CD_ABB-E
Airbus A319	2	1	0	0	0	152
Airbus A320	93	31	94	0	0	2429
Airbus A320neo	156	52	849	0	0	4859
Airbus A321	2	1	0	0	0	152
Airbus A321neo	39	13	283	0	0	759
Airbus A330	27	9	0	0	0	152
Airbus A330neo	24	8	0	0	0	0
Airbus A350	2	1	0	0	0	152
ATR 42	10	3	0	377	911	0
ATR 72	71	24	0	1887	4555	0
Boeing 737 MAX	298	99	1698	0	0	10476
Boeing 737-400	2	1	0	0	0	0
Boeing 737-800	44	15	0	0	0	1063
Boeing 767	7	2	0	0	0	152
Boeing 777	2	1	94	0	0	0
Boeing 777X	5	2	0	0	0	304
Boeing 787	32	11	94	0	0	304
Bombardier CS300	7	2	0	0	0	304
Bombardier Dash 8	12	4	0	94	228	0
Cessna 441	2	1	0	94	228	0
Embraer 145	2	1	0	0	0	152
Embraer 170	7	2	0	0	0	0
Embraer E190/195	2	1	0	0	0	0
Embraer E190-E2	34	11	0	0	0	911

Document Classification: Class 1 - General

2035 Permitted Operations Fleet Mix Continued

Aircraft Type	N28R Dep CD_ABBEY	N28R Dep CD_NEPOD	N28R Dep CD_NEP-E	N28R Dep CD_NEP-M	S10R Dep AB_LIFFY	S10R Dep AB_NEPOD
Airbus A319	76	0	0	0	0	0
Airbus A320	1215	987	987	987	0	0
Airbus A320neo	2429	1746	1746	1746	0	0
Airbus A321	76	0	0	0	0	0
Airbus A321neo	835	1291	152	152	0	0
Airbus A330	759	1366	0	0	0	0
Airbus A330neo	455	1594	0	0	0	0
Airbus A350	76	0	0	0	0	0
ATR 42	0	0	0	0	0	0
ATR 72	0	0	0	0	94	755
Boeing 737 MAX	5238	2581	2581	2581	0	0
Boeing 737-400	0	0	0	0	0	0
Boeing 737-800	531	607	607	607	0	0
Boeing 767	76	76	76	76	0	0
Boeing 777	0	228	0	0	0	0
Boeing 777X	152	0	0	0	0	0
Boeing 787	835	1442	76	76	0	0
Bombardier CS300	152	0	0	0	0	0
Bombardier Dash 8	0	0	0	0	0	377
Cessna 441	0	0	0	0	0	0
Embraer 145	76	0	0	0	0	0
Embraer 170	0	228	228	228	0	0
Embraer E190/195	0	0	0	0	0	0
Embraer E190-E2	455	304	304	304	0	0

Document Classification: Class 1 - General

2035 Permitted Operations Fleet Mix Continued

Aircraft Type	*S10R Dep CD_NEPOD*	*S10R Dep CD_LIFFY*	*S28L Dep AB_LIFFY*	*S28L Dep AB_NEPOD*	*S28L Dep CD_ROTEV*	*S28L Dep CD_LIFF-E*
Airbus A319	0	94	0	0	0	0
Airbus A320	1604	1887	0	0	380	380
Airbus A320neo	2736	2453	0	0	228	228
Airbus A321	0	94	0	0	0	0
Airbus A321neo	283	944	0	0	76	76
Airbus A330	94	944	0	0	0	0
Airbus A330neo	189	755	0	0	0	0
Airbus A350	0	94	0	0	0	0
ATR 42	0	0	0	0	0	0
ATR 72	0	0	228	1822	0	0
Boeing 737 MAX	4906	4906	0	0	76	76
Boeing 737-400	94	0	0	0	0	0
Boeing 737-800	944	755	0	0	228	0
Boeing 767	189	94	0	0	0	0
Boeing 777	0	0	0	0	0	0
Boeing 777X	0	189	0	0	0	0
Boeing 787	94	1038	0	0	228	0
Bombardier CS300	94	189	0	0	0	0
Bombardier Dash 8	0	0	0	911	0	0
Cessna 441	0	0	0	0	0	0
Embraer 145	0	94	0	0	0	0
Embraer 170	283	0	0	0	0	0
Embraer E190/195	94	0	0	0	0	0
Embraer E190-E2	660	660	0	0	76	76

Document Classification: Class 1 - General

2035 Permitted Operations Fleet Mix Continued

Aircraft Type	*S28L Dep CD_LIFF-M*	*S28L Dep CD_NEPOD*	*S28L Dep CD_NEP-E*	*S28L Dep CD_NEP-M*
Airbus A319	0	0	0	0
Airbus A320	380	304	304	304
Airbus A320neo	228	455	455	455
Airbus A321	0	0	0	0
Airbus A321neo	76	76	76	76
Airbus A330	0	76	76	76
Airbus A330neo	0	76	76	76
Airbus A350	0	0	0	0
ATR 42	0	0	0	0
ATR 72	0	0	0	0
Boeing 737 MAX	76	1366	1366	1366
Boeing 737-400	0	228	0	0
Boeing 737-800	0	152	152	152
Boeing 767	0	228	0	0
Boeing 777	0	0	0	0
Boeing 777X	0	0	0	0
Boeing 787	0	0	0	0
Bombardier CS300	0	76	76	76
Bombardier Dash 8	0	0	0	0
Cessna 441	0	0	0	0
Embraer 145	0	0	0	0
Embraer 170	0	0	0	0
Embraer E190/195	0	76	76	76
Embraer E190-E2	76	228	228	228

Document Classification: Class 1 - General

2035 Proposed Operations Fleet Mix

Aircraft Type	10L Arrivals	28R Arrivals	10R Arrivals	28L Arrivals	16 Arrivals	34 Arrivals
Airbus A319	94	0	0	228	2	1
Airbus A320	3491	0	94	8654	93	31
Airbus A320neo	5284	0	755	14576	156	52
Airbus A321	94	0	0	228	2	1
Airbus A321neo	944	0	283	2961	32	11
Airbus A330	566	0	377	2277	24	8
Airbus A330neo	755	0	189	2277	24	8
Airbus A350	94	0	0	228	2	1
ATR 42	377	0	0	911	10	3
ATR 72	2642	0	94	6605	71	24
Boeing 737 MAX	11134	0	849	28924	310	103
Boeing 737-400	0	0	94	228	2	1
Boeing 737-800	1415	0	189	3872	41	14
Boeing 767	94	0	189	683	7	2
Boeing 777	0	0	94	228	2	1
Boeing 777X	189	0	0	455	5	2
Boeing 787	1132	0	94	2961	32	11
Bombardier CS300	189	0	0	455	5	2
Bombardier Dash 8	472	0	0	1139	12	4
Cessna 441	94	0	0	228	2	1
Embraer 145	94	0	0	228	2	1
Embraer 170	283	0	0	683	7	2
Embraer E190/195	94	0	0	228	2	1
Embraer E190-E2	1321	0	0	3188	34	11

Document Classification: Class 1 - General

2035 Proposed Operations Fleet Mix Continued

Aircraft Type	16 Dep	34 Dep	N10L Dep CD_ABBEY	N10L-I Dep AB_ROTEV	N28R-I Dep AB_ROTEV	N28R Dep CD_ABB-E
Airbus A319	2	1	0	0	0	152
Airbus A320	93	31	377	0	0	3037
Airbus A320neo	156	52	944	0	0	4555
Airbus A321	2	1	0	0	0	152
Airbus A321neo	32	11	283	0	0	911
Airbus A330	27	9	0	0	0	152
Airbus A330neo	24	8	0	0	0	0
Airbus A350	2	1	0	0	0	152
ATR 42	10	3	0	377	911	0
ATR 72	71	24	0	1887	4555	0
Boeing 737 MAX	310	103	1132	0	0	10932
Boeing 737-400	2	1	0	0	0	0
Boeing 737-800	41	14	94	0	0	1063
Boeing 767	7	2	0	0	0	152
Boeing 777	2	1	94	0	0	0
Boeing 777X	5	2	0	0	0	304
Boeing 787	32	11	0	0	0	304
Bombardier CS300	5	2	0	0	0	152
Bombardier Dash 8	12	4	0	94	228	0
Cessna 441	2	1	0	94	228	0
Embraer 145	2	1	0	0	0	152
Embraer 170	7	2	0	0	0	0
Embraer E190/195	2	1	0	0	0	0
Embraer E190-E2	34	11	94	0	0	1063

Document Classification: Class 1 - General

2035 Proposed Operations Fleet Mix Continued

Aircraft Type	N28R Dep CD_ABBEY	N28R Dep CD_NEPOD	N28R Dep CD_NEP-E	N28R Dep CD_NEP-M	S10R Dep AB_LIFFY	S10R Dep AB_NEPOD
Airbus A319	76	0	0	0	0	0
Airbus A320	1518	911	911	911	0	0
Airbus A320neo	2277	1898	1898	1898	0	0
Airbus A321	76	0	0	0	0	0
Airbus A321neo	455	683	228	228	0	0
Airbus A330	759	1366	0	0	0	0
Airbus A330neo	455	1594	0	0	0	0
Airbus A350	76	0	0	0	0	0
ATR 42	0	0	0	0	0	0
ATR 72	0	0	0	0	94	755
Boeing 737 MAX	5466	3037	3037	3037	0	0
Boeing 737-400	0	0	0	0	0	0
Boeing 737-800	759	607	607	607	0	0
Boeing 767	76	76	76	76	0	0
Boeing 777	0	228	0	0	0	0
Boeing 777X	152	0	0	0	0	0
Boeing 787	835	1442	76	76	0	0
Bombardier CS300	76	76	76	76	0	0
Bombardier Dash 8	0	0	0	0	0	377
Cessna 441	0	0	0	0	0	0
Embraer 145	76	0	0	0	0	0
Embraer 170	0	228	228	228	0	0
Embraer E190/195	0	0	0	0	0	0
Embraer E190-E2	531	380	380	380	0	0

Document Classification: Class 1 - General

2035 Proposed Operations Fleet Mix Continued

Aircraft Type	S10R Dep CD_NEPOD	S10R Dep CD_LIFFY	S28L Dep AB_LIFFY	S28L Dep AB_NEPOD	S28L Dep CD_ROTEV	S28L Dep CD_LIFF-E
Airbus A319	0	94	0	0	0	0
Airbus A320	1510	1698	0	0	152	152
Airbus A320neo	3114	1981	0	0	76	76
Airbus A321	0	94	0	0	0	0
Airbus A321neo	472	472	0	0	0	0
Airbus A330	94	944	0	0	0	0
Airbus A330neo	189	755	0	0	0	0
Airbus A350	0	94	0	0	0	0
ATR 42	0	0	0	0	0	0
ATR 72	0	0	228	1822	0	0
Boeing 737 MAX	5189	5661	0	0	0	0
Boeing 737-400	94	0	0	0	0	0
Boeing 737-800	849	660	0	0	0	0
Boeing 767	189	94	0	0	0	0
Boeing 777	0	0	0	0	0	0
Boeing 777X	0	189	0	0	0	0
Boeing 787	94	1132	0	0	228	0
Bombardier CS300	94	94	0	0	0	0
Bombardier Dash 8	0	0	0	911	0	0
Cessna 441	0	0	0	0	0	0
Embraer 145	0	94	0	0	0	0
Embraer 170	283	0	0	0	0	0
Embraer E190/195	94	0	0	0	0	0
Embraer E190-E2	660	566	0	0	0	0

Document Classification: Class 1 - General

2035 Proposed Operations Fleet Mix Continued

Aircraft Type	S28L Dep CD_LIFF-M	S28L Dep CD_NEPOD	S28L Dep CD_NEP-E	S28L Dep CD_NEP-M
Airbus A319	0	0	0	0
Airbus A320	152	304	304	304
Airbus A320neo	76	607	607	607
Airbus A321	0	0	0	0
Airbus A321neo	0	152	152	152
Airbus A330	0	76	76	76
Airbus A330neo	0	76	76	76
Airbus A350	0	0	0	0
ATR 42	0	0	0	0
ATR 72	0	0	0	0
Boeing 737 MAX	0	1139	1139	1139
Boeing 737-400	0	228	0	0
Boeing 737-800	0	76	76	76
Boeing 767	0	228	0	0
Boeing 777	0	0	0	0
Boeing 777X	0	0	0	0
Boeing 787	0	0	0	0
Bombardier CS300	0	0	0	0
Bombardier Dash 8	0	0	0	0
Cessna 441	0	0	0	0
Embraer 145	0	0	0	0
Embraer 170	0	0	0	0
Embraer E190/195	0	76	76	76
Embraer E190-E2	0	152	152	152

Document Classification: Class 1 - General

Annex 3: Estimated population and areas for healthcare facilities in the Dublin area

Noise Consultant Reference	Name	Easting	Northing	Population	Area (hectares)
HEA001	Leopardstown Park Hospital	319979.36	225720.272	394	1.5
HEA002	LauraLynn - Ireland's Children's Hospice	320378.84	226259.083	40	1
HEA003	National Rehabilitation Hospital	323286.41	226618.103	460	3.2
HEA004	Belmont House Nursing Home	321000.656	227031.594	322	2
HEA005	Herberton Nursing Home	325129.392	227480.353	76	0.3
HEA006	St John of God Hospital	320666.872	227651.202	366	1.2
HEA007	Adelaide And Meath Hospital	308195.798	227903.543	1124	8
HEA008	Hawtorns HSC Hospital	320454.766	228385.886	46	0.1
HEA009	Carrick Manor Nursing Home	323285	228505.203	180	2.3
HEA010	St Micheal's Hospital	324214.731	228648.414	260	3
HEA011	Central Mental Hospital	317260.741	229215.098	168	1.2
HEA012	Holy Family Residence Nursing Home	318228.636	229579.955	120	1.3
HEA013	St Mary's Centre Nursing Home	319606.5	230862.766	112	1
HEA014	Clonskeagh Hospital	317291.969	230860.188	30	0.1
HEA015	St Vincent's Private Hospital	319399.299	230919.23	580	1
HEA016	St Vincent's University Hospital	319125.969	231053.234	1200	6
HEA018	Peamount Hospital	301297.844	230735.141	240	1
HEA019	Saint John's House Nursing Home	319333.619	231235.95	112	0.5
HEA020	The Royal Hospital Donnybrook	316772.427	231907.252	356	1.7
HEA021	Ailesbury Private Nursing Home	319174.004	231981.076	90	0.1
HEA022	Our Lady's Children's Hospital	312080.585	231933.934	500	4.7
HEA023	The Brabazon Trust Nursing Home	319335.406	232385.766	100	0.1
HEA024	Royal Victoria Eye & Ear Hospital	316220.819	232789.224	160	1
HEA026	St John of God Celbridge Care Home	296927.313	232899.125	126	0.6
HEA029	St. James Hospital	313769.787	233486.71	2000	9.4
HEA030	National Maternity Hospital	316879.336	233631.767	308	1
HEA032	Cherry Orchard Hospital	308060.044	233780.618	322	6.5

Document Classification: Class 1 - General

Estimated population and areas for healthcare facilities in the Dublin area continued

Noise Consultant Reference	Name	Easting	Northing	Population	Area (hectares)
HEA033	St Patrick's University Hospital	313814.964	233975.372	482	1.9
HEA035	Maryfield Nursing Home	309993.188	234577.875	110	0.7
HEA036	St Mary's Hospital	310817.053	234621.068	96	1.5
HEA037	Rotunda Hospital	315669.146	235069.494	376	2
HEA039	Mater Private Orthopaedic and Spine Centre	315579.593	235446.091	100	0.1
HEA040	Temple Street Children's University Hospital	315765.47	235457.882	308	3
HEA041	Mater Private Hospital	315610.5	235580.965	400	0.7
HEA042	Saint Monica's Nursing Home	316022.171	235626.197	92	0.4
HEA043	Mater Misericordiae University Hospital	315346.906	235726.37	1200	4.1
HEA044	St Edmundsbury Hospital	304057.969	235880.859	104	0.5
HEA045	St Vincent's Hospital Fairview	316864.474	236394.507	60	0.5
HEA046	Clontarf Hospital	319760.911	236709.087	208	1.1
HEA047	Farview Community Unit Care Centre	316989.313	236707.422	160	0.8
HEA048	Gheel Autism Services (residential)	317073.132	236725.674	20	0.3
HEA049	Mount Hybla Nursing Home	309234.094	236568.75	132	1
HEA050	Daughters of Charity Disability Services Care Home	311546.191	236704.974	72	3
HEA051	Nazareth House Nursing Home	318220.208	237102.348	60	1.1
HEA052	Howth Hill Nursing Home	329475.331	237791.421	110	0.2
HEA053	Bon Secours Hospital Dublin	315358.18	237561.988	300	1
HEA054	Highfield Private Hospital	316865.9	237877.5	220	1.4
HEA055	Beech Lawn Nursing Home	317001.274	237944.118	114	0.5
HEA056	Raheny House Nursing Home	321066.311	238057.722	86	0.3
HEA057	Saint Clare's Nursing Home	315075.563	238117.656	80	0.3
HEA058	St Joseph's Hospital	321181.458	238453.544	56	2.3
HEA059	Saint Francis Hospice	321489.585	238724.967	36	0.5
HEA060	St Joseph's Care Centre	304348.594	238565.375	136	1

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Estimated population and areas for healthcare facilities in the Dublin area continued

Noise Consultant Reference	Name	Easting	Northing	Population	Area (hectares)
HEA062	Connolly Hospital Blanchardstown	308621.207	238816.27	814	5.5
HEA063	Beneavin Lodge Nursing Home	314208	238971.297	140	0.8
HEA064	Beaumont Hospital	318236.438	239272.328	1640	8.4
HEA065	Saint Patricks Nursing Home	324453.185	239996.205	136	1
HEA066	Silver Stream Nursing Home	315594.333	240201.043	108	0.3
HEA067	Tlc Nursing Home	316271.75	240846.047	184	0.4
HEA068	St Doolagh's Park Care & Rehabilitation Centre	321372.2	241919.7	144	0.35
HEA071	Clonmethan Lodge Hospital	311530.406	253277.016	60	0.6
HEA072	St Joseph's Community Nursing Unit	280241.539	256344.603	100	1.3
3848/16	Not yet built nursing home	318728.9846	239249.7003	448	1.6
2650/15	Not yet built nursing home	320382.7931	239406.0847	298	1
2898/13	Not yet built nursing home	321085.7525	241038.4161	294	1
RA150531	Not yet built nursing home	301405.4342	241640.334	120	1
F14A/0145	Not yet built nursing home	315576.685	240574.3931	228	1
F18A/0401	Not yet built nursing home	321310.948	241781.8831	112	1
F13A/0012	Not yet built nursing home	318727.185	243438.5795	178	0.6

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Appendix 9A. Mobility Management Update 2019

Document Classification: Class 1 - General

DublinAirport

MOBILITY MANAGEMENT UPDATE

AUGUST 2019


1-28
Arrivals
ATM
29-56

CONTENTS

Acronyms

CAR	Commission for Aviation Regulation
DAC	Dublin Airport Central
FCC	Fingal County Council
GTC	Ground Transportation Centre
IATA	International Air Transport Association
MMP	Mobility Management Plan
NAP	National Aviation Policy
NTA	National Transport Authority
NPF	National Planning Framework
PRM	Persons of Reduced Mobility
SPSVs	Small Public Service Vehicles
TII	Transport Infrastructure Ireland
TFI	Transport for Ireland
WTP	Workplace Travel Plan

DublinAirport

FOREWORD

DUBLIN AIRPORT IS A GROWING AIRPORT THAT SERVES AS A MAJOR TRANSPORT HUB FOR MILLIONS OF BUSINESS AND LEISURE TRAVELLERS, A GATEWAY FOR TOURISM AND FOREIGN DIRECT INVESTMENT AND A CRITICAL FACILITATOR OF CONNECTIVITY FOR AN ISLAND NATION. PASSENGER TRAFFIC THROUGH DUBLIN AIRPORT HAS GROWN EXPONENTIALLY IN RECENT YEARS.

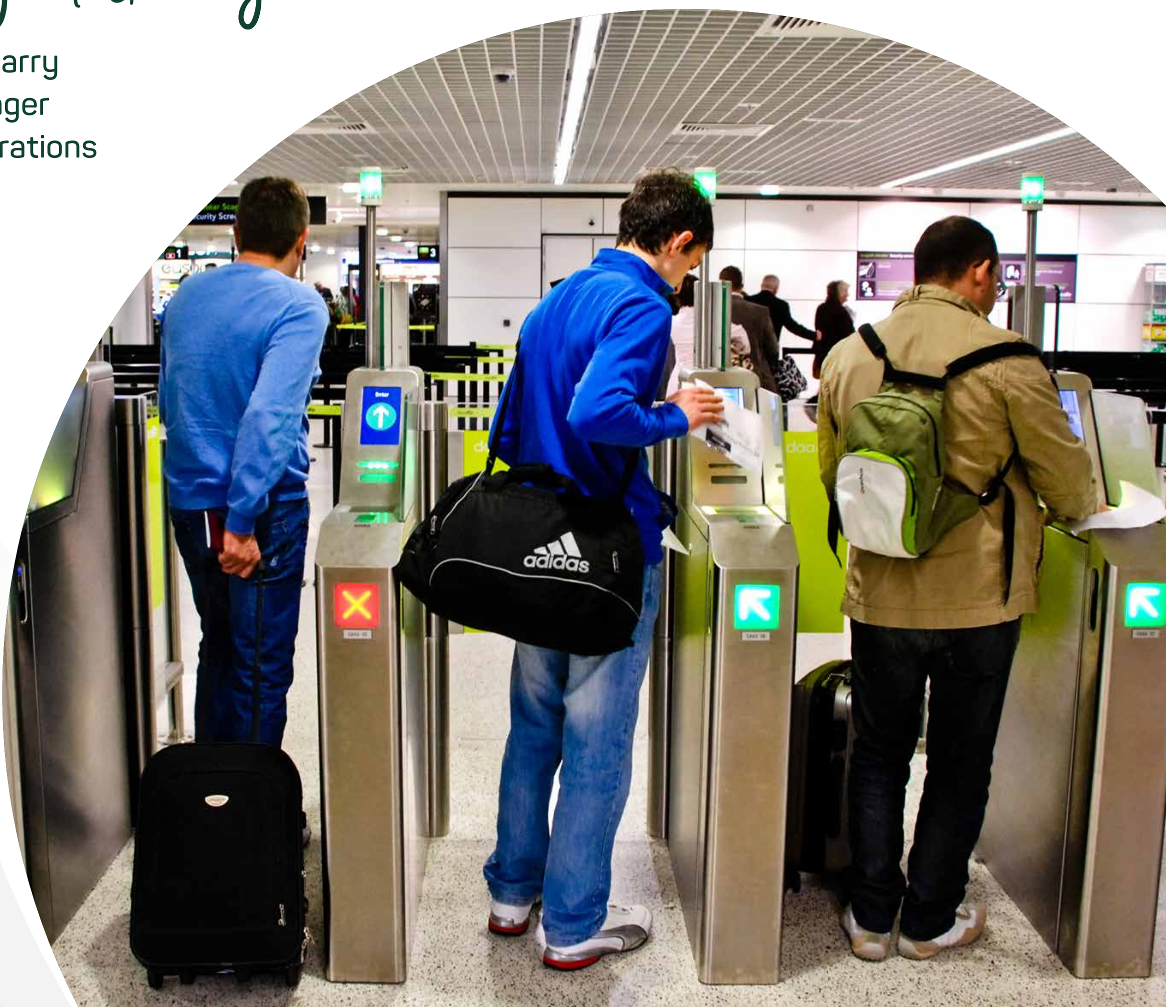
Dublin Airport welcomed a total of 31.5 million passengers during 2018, setting a new record for the airport. 2018 represented the eighth consecutive year of passenger growth at Dublin Airport. Amidst this prolonged period of growth Dublin Airport maintains a vision to deliver a quality airport travel experience to the very best international standards. Providing good surface access is a key element of delivering a quality travel experience and this is recognised by the National Planning Framework which identifies improving access to Dublin Airport as a key future growth enabler for Dublin.

We support and encourage uptake of public transport by employees and passengers alike. Through incentives, promotion and improvements to the range of transport choices, we hope to encourage more sustainable travel choices.

We are keenly aware that mobility management is an ongoing challenge and requires continuity with regards to initiatives and promotions. This MMU provides an update on some of the ongoing and new initiatives which have been implemented at Dublin Airport since the preparation of the last MMU.

Anthony McGarry

Anthony McGarry
Mobility Manager
Landside Operations



EXECUTIVE SUMMARY

'Surface access' is the term used to describe how people access an airport – other than by air. The Dublin Airport Mobility Management Update (MMU) 2019 is a biennial update of Dublin Airport's sustainable surface access plan for passengers and employees. It presents the most recent information on travel patterns to and from the airport and details mobility management initiatives being used in support of sustainable travel patterns.

Dublin Airport welcomed a record total of 31.5 million passengers during 2018. This set a new passenger record and represented the eighth consecutive year of passenger growth at the airport. Passenger numbers at Dublin Airport have increased by 3.6 million since 2016, an overall increase of 12.9%.

Dublin Airport aims to provide quality surface access to passengers as part of the overall objective to deliver a quality travel experience. The main aim of the Mobility Management Plan is to encourage more sustainable travel choices, reducing congestion and lowering emissions through incentives, promotion and improvements to the range of transport choices.

Some key facts from the 2019 MMU:

- The peak period for passengers arriving at Dublin airport is from 05:00 to 07:00 – when public transport options are limited;
- There has been a decrease in the share of passengers arriving at Dublin Airport by private car, declining from 33.4% in 2016 to 32.7% in 2018.
- Bus access by passengers continues to account for almost one third of trips to Dublin Airport, accounting for a 32.2% share in 2018; and,
- Between 2016 and 2018 there has been a 7% reduction in the share of staff travelling to Dublin Airport by car.

1.0 INTRODUCTION

The MMU sets out measures which promote sustainable transport. Passenger numbers at Dublin Airport increased from 27.9m in 2016 to a record 31.5m passengers in 2018, an overall increase of 12.9%. The International Air Transport Association (IATA) anticipates that global air traffic demand could double by 2037.[1]

'Surface access' is the term used to describe access to an airport by land – i.e. other than by air. Good surface access is critical to achieving airport growth, contributes to the experience of passengers and is essential to the airport's continued safe and efficient operation.

The MMU is updated every two years. While this version provides an update with regard to the initiatives and objectives contained within the 2017 MMU, a new Mobility Management Plan is currently being prepared and will set sustainable travel objectives for the coming years.
The MMU reaffirms a commitment to sustainable modes of transport and ensures Dublin Airport is contributing to the role of the transport authorities in encouraging both passengers and employees to choose these modes when making their journey. In this way, Dublin Airport wishes to continue to play its part in reducing congestion, commute times, energy and emissions as well as making best use of airport infrastructure.
The MMU recognises that the private car plays a necessary role in accessing Dublin Airport, particularly at off peak times and where public transport is unavailable. The highest throughput of passengers departing the airport daily is on the first flights between 6 and 7 am. Allowing for time to travel to the airport, check-in and passing security, passengers must leave their homes before most public transport is operating.

The 2019 MMU focuses on the following key areas:

- Reporting on existing travel patterns at Dublin Airport;
- Setting out current sustainable transport initiatives at Dublin Airport;
- Reviewing the effectiveness of the MMU Objectives; and,

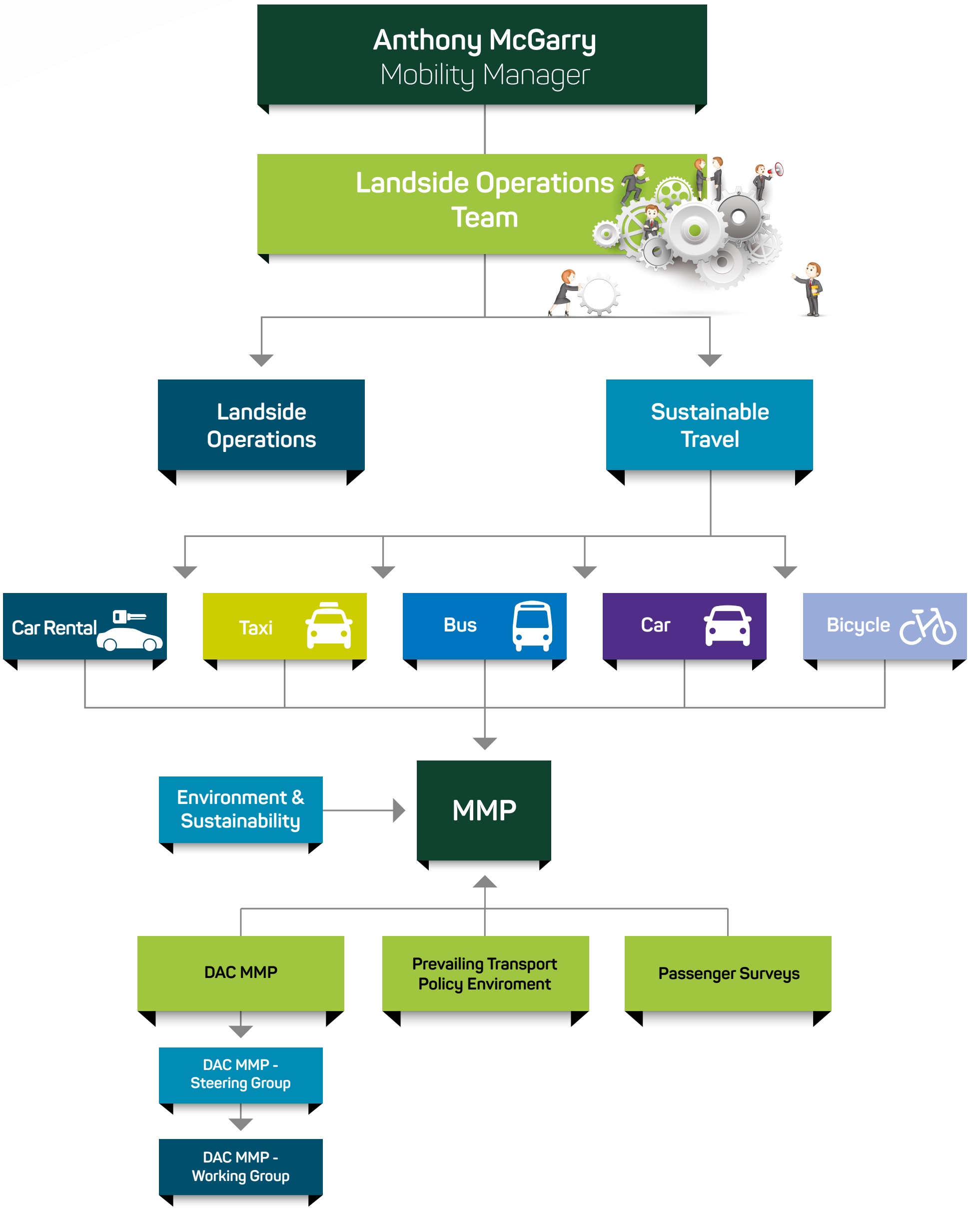
Dublin Airport also acknowledges the transport policy environment in which this update occurs, including:

- South Fingal Transport Study, 2019, Fingal County Council
- Project Ireland 2040 National Planning Framework
- Transport Strategy for the Greater Dublin Area 2016-2035, NTA
- Capital Investment Plan, 2016-2021, Department of Public Expenditure and Reform
- Fingal/North Dublin Transport Study, 2015, NTA
- Smarter Travel – A Sustainable Transport Future 2009-2020, Department of Transport

1.1 INTRODUCTION TO THE LANDSIDE OPERATIONS TEAM

Responsibility for surface access at Dublin Airport rests with the Landside Operations Team under the stewardship of the Mobility Manager. One of key responsibilities of the team is to foster continued improvement in the range services that are offered in terms of smarter travel choices. The 2019 MMU has been shaped by this team and their efforts to champion smarter travel options and encourage uptake amongst users.

1. IATA Press Release No. 62, 24th October 2018



Dublin Airport has used data from passengers and employee surveys, as well as inputs from the NTA, to ensure a clear understanding of how and when people access the airport, including how far they have travelled. In so doing, Dublin Airport can better understand surface access needs of airport users and use capability to make improvements.

The MMU also takes account of Dublin Airport Central (DAC). The first phase of DAC is nearing completion (with the first block being occupied since 2017), consisting of office space located within the airport's central core. Under the DAC Mobility Management Plan, each future tenant will be required to appoint a Workplace Travel Plan Coordinator as a representative to promote and encourage use of sustainable transport including active commuting, public transport and car management. This representative will sit on the DAC Working Group.

Dublin Airport is keenly aware that good access to information on sustainable transport choices is key to influencing commuter and passenger choices when making their trip to Dublin Airport. Successful implementation of this MMU will rely on effective promotion of sustainable transport to the widest audiences possible, including DAC.

2.0 GETTING TO DUBLIN AIRPORT TODAY

Understanding how Passengers access Dublin Airport

In the absence of a rail link, surface access to Dublin Airport is necessarily by road. The vast majority of people travel to the airport by bus, taxi or car. Accessing by active means (walking and cycling) is more difficult, the airport is located remote from where people live.

During 2018, **over 2 million** passengers arrived by air and departed immediately again by air (transfer and transit passengers) never having interacted with the surface access network

Changing mind-sets and travel behaviours to more sustainable travel choices remains a challenge and planning for good surface access for passengers must recognise that:

- Dublin Airport serves the island of Ireland and must cater for passengers travelling from destinations which may not have public transport links;
- Passengers travel with bags and luggage, include families and are sometimes facing/coming from long journeys once they reach Dublin Airport – therefore, convenience and ease of access at either end are a key consideration;
- There is currently no rail link connecting Dublin Airport to Dublin City Centre;
- The highest throughput of passengers departing the airport daily is on the first flights between 6 and 7 am. Allowing for time to travel to the airport, check-in and passing security, passengers must leave their homes before most public transport is operating.

Encouraging and facilitating sustainable travel is a strategic objective of Dublin Airport. Through a careful balance of aspiration and reality, we can continue to meet passenger needs and ensure we have an efficient effective national airport.

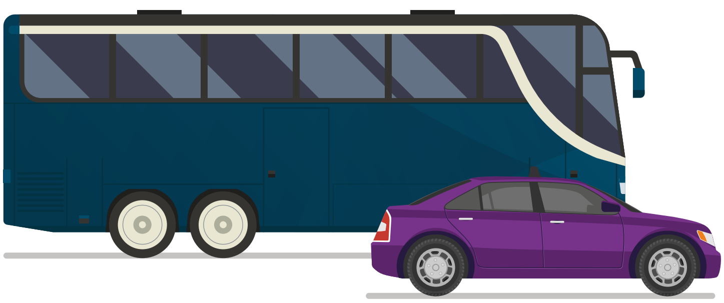
2.1 ACCESS BY BUS

Bus-based public transport is one of the principal means of accessing Dublin Airport – accounting for almost one third of passenger modal split during 2018. To put this in context, the airport has more daily bus movements than Busáras, Dublin City's central bus station, with almost 1,500 bus movements into and out of Dublin Airport daily.

Dublin Airport facilitates buses by way of:

- Dedicated bus only drop-offs at the kerbsides nearest to the terminal buildings;
- Dedicated set down lanes for local buses and through routes to the rear of Terminal 1 Multi-Storey Car Park;
- A coach park for longer distance and longer turnaround coach parks at the Ground Transportation Centre. This site is equidistant to Terminals 1 and 2. It is further augmented by a coach layover area in the Red Car Park which facilitates bus routes that have longer times between their arrival and departure slots.
- Coach parking, bus stops and ticket purchasing in easily accessible locations to the terminals.

The NTA has also been undertaking public consultations with regards to the BusConnects project. BusConnects aims to overhaul the current bus system in Dublin through a 10 year programme of integrated actions to deliver a more efficient, reliable and better bus system for more people. The proposal aims to deliver 230kms of dedicated bus lanes and 200kms of cycle tracks along 16 of the busiest corridors in Dublin. Dublin Airport is located along the Swords to City Centre BusConnects corridor which is identified as a Phase 1 corridor. Dublin Airport welcomes and supports BusConnects as an enabler of a more efficient and effective public transport system for the Dublin Area and continues to engage with the NTA on such proposals.



53%

The number of passengers travelling to Dublin Airport by bus and taxi

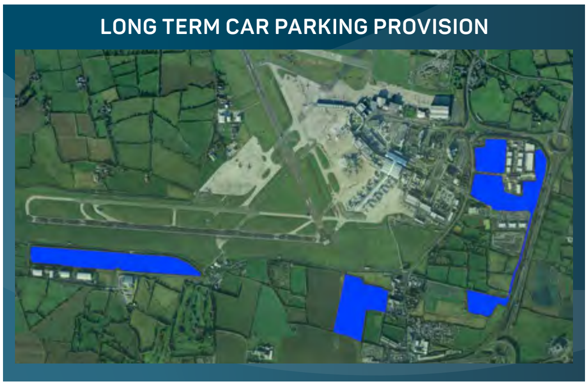
2.2 ACCESS BY PRIVATE CAR

The private car will continue to form an essential part of the range of modes available to passengers at Dublin Airport. In addition to private car, passengers also access the airport via taxi/small public service vehicle (SPSVs) and car hire vehicles. As with any international airport, a range of parking is available including short term and long term.

Passengers Parking

Existing passenger parking comprises short-term and long-term parking. Short term parking is principally provided within walking distance of the terminal buildings in multi-storey car parks.

Long term surface car parking is located further away from the terminal buildings due to the requirement for large areas of space not readily available in the central area. Long term car parks require good access from the external road network and frequent shuttle connections to the terminal buildings.



Employee Parking

Employee parking is dispersed across the campus, reflecting the different zones and dispersed nature of activities. The majority of staff parking is in the eastern part of the campus.

3.0 EXISTING TRAVEL PATTERNS

The following section details existing travel patterns at Dublin Airport. It draws principally on two Dublin Airport surveys – a Passenger Insights Survey and a Staff Travel Survey.

Both surveys are independently undertaken by external research and marketing consultants on behalf of daa, to ensure impartiality and robustness.

APPROXIMATELY 23,000 INTERVIEWS WERE CONDUCTED THROUGHOUT 2018 ON BEHALF OF DUBLIN AIRPORT WITH DEPARTING PASSENGERS; DATA IS GATHERED USING FACE-TO-FACE INTERVIEWS AT DEPARTING GATES AND IS BASED ON A SAMPLE THAT COVERS 95% OF ALL SCHEDULED FLIGHTS.

Dublin Airport has continued to experience exponential growth in passenger numbers. Passenger numbers increased by 6% to a record 31.5 million during 2018. This represents a 12.9% increase in passenger numbers between 2016 and 2018 and a 45% increase in passenger numbers since 2014, making it one of the fastest-growing large airports in Europe during that period.

While the data below sets out the percentage split of modal choice, it is noteworthy that these figures have been achieved across significantly bigger actual volumes.

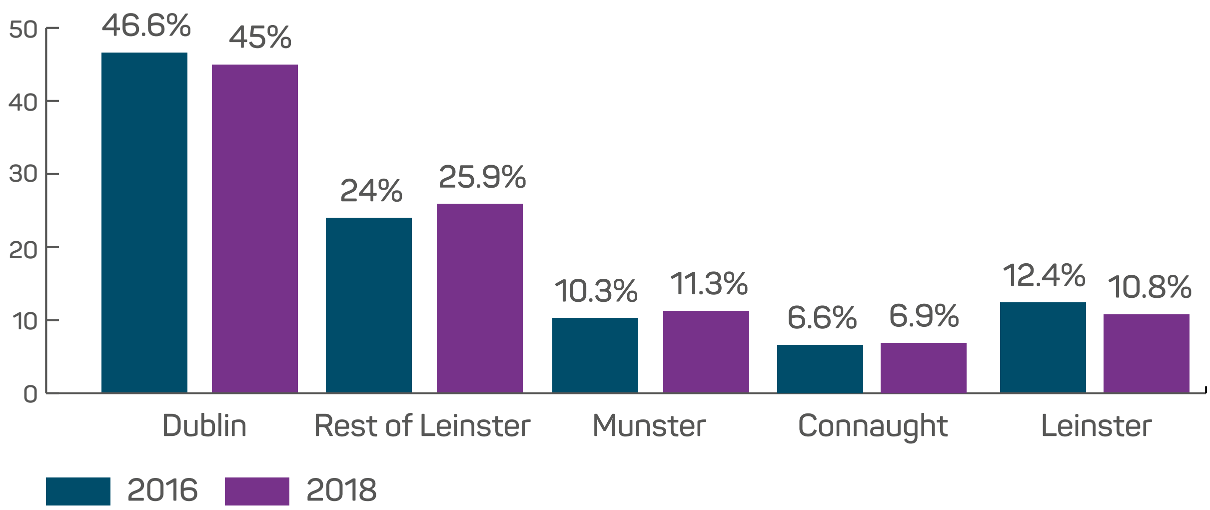
Early Wake Up

10% of all passengers depart Dublin Airport before 8am.
On a busy summer's day, Dublin Airport processes 100,000 passengers.

3.1 ORIGIN OF PASSENGERS

The 2016 NTA State Airport Survey confirmed that nearly 70% of all passengers travel to the airport from within Dublin, rising to nearly 80% for the Greater Dublin Area. Travel demand is heavily concentrated within the GDA – reflecting, amongst other factors, the higher population base relative to the rest of the country.

The more recent daa Passenger Tracker Survey 2018 confirms that the largest proportion of passengers continue to originate from Dublin and the rest of Leinster (70.9% of surveyed passengers). There has also been a slight increase in passengers originating from both Munster and Connaught, with a combined increase from 16.9% in 2016 to 18.2% in 2018.



Source Dublin Airport Passenger Insights Survey, 2016 and 2018

3.2 PASSENGER MODE SHARE

THERE HAS BEEN A DECREASE IN THE SHARE OF PASSENGERS ARRIVING AT DUBLIN AIRPORT BY CAR, DECLINING FROM 33.4% IN 2016 TO 32.7% IN 2018.

Conversely there has been a steady increase in the share of passengers arriving by rental car, up from 4.7% in 2016 to 5.9% in 2018. This increasing demand for rental cars has been evident since 2012 and is reflective of the increase in overseas visitors to Ireland during this period.[2]

There has been a marginal decline in the share of passengers taking the bus to Dublin Airport between 2016 and 2018. However, noting that the overall passenger numbers at the airport have increased significantly in this period (up from 27.9 million in 2016 to 31.5 million passengers in 2018) this equates to an overall increase in the total number of passengers taking the bus to Dublin Airport during this period.

Figures provided in the table which follows are based on proportions of all departing passengers –including those transferring from other flights (transfer passengers) or those whose aircraft may land for refuelling but who do not leave their aircraft (transit passengers). These passengers (approximately 2.1 million) have no surface access requirements, and arrive and depart without placing any demand on the airport's road and transport network.

Passenger Mode Share (%)*

Transport Mode	2006	2011	2012	2014	2016	2018
Car – Private	44.0%	40.0%	34.0%	33.3%	33.4%	32.7%
Car – Rental	5.0%	-	4.0%	4.5%	4.7%	5.9%
Bus	24.0%	33.0%	34.5%	34.3%	34.0%	32.2%
Taxi	26.0%	24.0%	26.5%	21.7%	21.5%	20.8%
Bicycle/Motorbike/Other	1.0%	3.0%	1.0%	1.4%	1.2%	1.1%
International Flights/Transfer Passengers	-			4.8%	5.3%	7.2%

Source Dublin Airport Passenger Insights Survey

3.3 EMPLOYEE MODE SHARE

There has been a significant decline in the number of employees driving to work and a corresponding increase in the number of employees taking a bus/coach to work.

THE PROPORTION OF EMPLOYEES DRIVING TO WORK HAS DECLINED FROM 67% IN 2016 TO 60% IN 2018.

This important shift has been achieved coupled by an overall increase in employment levels at Dublin Airport over the same period. Similarly, there has been a significant increase in the proportion of employees taking a bus/coach to work, up from 21% in 2016 to 29% in 2018. This reflects the increased range of bus routes now serving Dublin Airport and is evident in the increased number of employees availing of the Bus TaxSaver scheme (up 33% between 2016 and 2018).

2. Overseas Trips to Ireland by Non-Residents, CSO, Tourism and Travel Annual Series TMA09, 2019

Employee Mode Share (%)

Transport Mode	2010	2012	2014	2016	2018
Car – Driver	64	68	67	67	60
Car – Passenger	8	6	6	5	6
Bus/Coach	21	18	19	21	29
Taxi	n/a	4	3	4	2
Bicycle, Motorbike	3	2	4	2	2
Other	4	2	1	1	2

Source Dublin Airport Staff Travel Survey

An examination of the distribution of staff origins across the GDA indicates a very clear cluster of travel demand around Swords, where 18% of staff trips originate. There is also a high concentration of airport staff living in North Dublin between the City Centre and the M50. The average trip duration to work was 28 minutes, with 69% of people living less than 20km from Dublin Airport. Approximately 30% of employees on the airport campus start their daily shift between 00:00 and 06:00, which is generally outside of public transport hours.

3.4 PASSENGER COMPARATIVE PERFORMANCE

A benchmark of other airports (Heathrow, Gatwick, Schiphol, Madrid, Rome and Barcelona) highlights the following:

- Dublin Airport is the 15th largest airport in Europe;
- Dublin Airport is one of only four of the Top 20 European airports (in terms of passenger numbers) without a rail link;
- Accessibility by car continues to play an important role as the predominant mode of travel to the majority of European airports.

% Using Public Transport

Airport	Passengers Per Annum (2018)	No. of Terminals	Distance from City Centre	Passengers
London Heathrow	80.1m	4	23km	40%
London Gatwick	46.1m	2	40.3km	44%
Amsterdam Schipol	71.1m	1	12.0km	40%
Barcelona-El Prat	50.1m	2	12km	21%
Dublin	31.5m	2	10km	33%

4.0 DUBLIN AIRPORT TRAVEL INITIATIVES

Since the completion of the 2017 MMU Dublin Airport has sought to further improve sustainable travel initiatives with a view to maintaining and growing sustainable transport alternatives for both employees and passengers.

The following section details these initiatives, some of which are being newly trialled and which it is hoped will positively influence sustainable travel mode share over the next number of years.

Employee Travel Initiatives

Dublin Airport continues to be a Smarter Travel Workplace; that means that we have partnered with the NTA's Smarter Travel initiative to promote and support greater travel choice away from the private car in favour of more sustainable transport means for all Dublin Airport employees.

4.1 ACTIVE COMMUTE

Active Commuting includes any form of travel to and from work by means of walking, running or cycling – or a combination of these with another transport mode. As well as being convenient and relatively inexpensive, Active Commuting brings tangible health benefits in terms of physical activity, enjoyment and general well-being for the user.

Dublin Airport supports Active Commuting though a range of measures including continuous promotion, investment in facilities, as well as participation in available tax saver schemes. There is an annual raffle for bicycle and cycling equipment, and daa are working to ensure adequate shower and locker facilities are available. Dublin Airport Central have developed Grade A locker, shower and drying room facilities in each office building, specifically designed on the ground floor to accommodate separate access directly from enclosed bicycle shelters. daa are working to ensure the remaining buildings have access to adequate shower and locker facilities. The combined effect of these efforts is to positively increase Active Commuting as a means of getting to and from the airport, with all the attendant health benefits for employees.

Cycling to Work

Dublin Airport has an excellent network of cycle paths internally and around the campus, with over 6km of cycle lanes and 250 bicycle parking spaces. This makes cycling particularly safe and user friendly for both employees and the general public. The ongoing development of Dublin Airport Central has further enhanced the cycle lane network. Cycle lanes have been extended directly through the parkland of the Dublin Airport Central development which provides direct route access from the existing cycle lane network to each enclosed bicycle parking structure.

Dublin Airport supports the ambitions of the National Cycle Policy Framework 2009-2020 to develop a culture of cycling to work in Ireland, and is a participant in the Cycle to Work Scheme, a government tax initiative aimed at meeting this objective. Under this scheme, Dublin Airport purchase bicycles and cycling equipment for employees through a salary sacrifice arrangement - which is not liable for tax, PRSI or the Universal Social Charge. Employees can apply for the scheme online, making the process accessible and straightforward. Participation in the Cycle to Work Scheme has increased by 15% over the last two years.

Dublin Airport actively supports the culture of cycling in the workplace with the annual Nicola Radford Charity Cycle held each Autumn and participation in the annual Smarter Travel Cycle Challenge. The Smarter Travel Cycle Challenge, which is part of the NTA's Smarter Travel Workplace initiative takes place during Bike Week and involves teams of 3-6 employees logging their total cycling distance throughout the week. The aim of the challenge is to encourage and support employees to cycle more, aiming to increase the number of cycle journeys undertaken in day to day living and in particular on the daily commute.

Walking to Work

Walking to work at Dublin Airport is more challenging than most other places of employment as, by its nature, the airport it is not located close to where people live. Accepting this challenge, walking is encouraged as part of an overall commute, which might also include public transport or lift sharing. Onsite, the airport offers a safe walking environment, with well-lit, well-signposted, safe routes across the entire campus. Dublin Airport participates in the NTA's annual Smarter Travel 'Step Challenge' which takes place over four weeks every year.

The Dublin Airport Central 5k Fun Run is held annually on campus and encourages staff to promote an active life. Participation in the event has been increasing year on year and over 500 people participated in this year's event.

4.2 PUBLIC TRANSPORT INCENTIVES

Bus TaxSaver Scheme

Dublin Airport is a participating employer in the Bus Taxsaver Scheme. Under this scheme, an annual or monthly commuter ticket is purchased by Dublin Airport on behalf of participating employees. Similar to the Cycle to Work Scheme, the cost of the ticket is then deducted from the employee's gross salary, thus reducing the taxable element. Increased promotion of the Bus Taxsaver scheme over the last two years has resulted in a significant increase in employee participation in the scheme – up 33% between 2016 and 2018. This is evidenced by the 8% increase in bus-based employee mode share witnessed between 2016 and 2018.

Staff Travel Card

Dublin Airport has developed a Staff Travel Card initiative, which allows employees to avail of the full range of public transport services to and from Dublin Airport and avail of significant staff discounts on these services. 8,000 Staff Travel Cards have been distributed across the campus throughout 2018 and 2019. Dublin Airport has also engaged with a number of bus operators to secure a significant 50% staff discount on a number of primary bus routes to and from the airport. One such service is the Airlink service which has recorded approximately 50,000 transactions using the Staff Travel Card to date. This initiative has been a direct output from the Workplace Travel Plan Working Group and has helped to further increase the share of bus-based journeys amongst employees.

Log-on-Hop-on

Given the 24-hour nature of Dublin Airport, many employees work outside normal business hours when public transport services are not available. Log-on- Hop-on is shared transport service available to shift workers, running nightly between 10pm and 6am. It operates within a 15km radius of Dublin Airport. Employees who have purchased tickets, can pre-book the service on the Log-on-Hop-on website, and book a bus to collect them at home or at a local pick up point, and transfer them to Dublin Airport. A similar arrangement is in place for the return journey home. This initiative has continued to grow since 2016 and has now been brought under the Bus TaxSaver scheme, allowing employees to avail of significant monthly, quarterly or annual discounts through their salary. The opportunity for employees to avail of the Log-on- Hop-on service in conjunction with a TaxSaver ticket acts a significant incentive for employees to utilise the service.

GOCar

Dublin Airport has partnered with GOCar to provide an employee car sharing service for employees who may need occasional access to cars while in work. It is hoped that this will facilitate employees wishing to commute to the airport by either active commuting or by public transport, but who may require a car during the day for meetings. Four car parking spaces have been designated between Terminal 1 and Terminal 2 for the GoCar initiative to operate at Dublin Airport. Dublin Airport has been reviewing the key learnings from the roll out of this scheme and will be reengaging with GoCar this year with a view to exploring further ways to develop the scheme within the airport campus.

Car Sharing

Having initially been established under the umbrella of carsharing.ie (an initiative of the NTA and Smarter Travel Workplaces) the scheme has evolved incrementally through internal networks including business units, social media and internal company platforms such as Yammer. These platforms facilitate instant communication among employees and make car sharing arrangements easier for employees.

Car sharing provides an opportunity for Dublin Airport employees to save money on tolls and fuel costs, reduce wear and tear on their car, reduce their carbon footprint and get to know other colleagues. The benefits of car sharing as a commuting option will also be outlined to each employee as part of plans to trial Personal Travel Plans for each employee.

Mobility Solutions

Dublin Airport has recently issued a tender for mobility solutions within the airport campus. The trial is aiming to provide different modes of transport for staff on the airport campus such as shared cars, scooters, bikes, e-bikes etc. The trial is designed to understand market capability in providing such services and to understand the level of staff uptake for different modes of transport. These campus based solutions will be aimed at reducing the level of car dependency as a mode of transport amongst staff.

4.3 INFORMATION CAMPAIGNS & PROMOTION

All employee sustainable travel initiatives are supported through a concerted effort by Dublin Airport in terms of information sharing, internal marketing and updates on employee email newsfeeds. The Landside Operations Team regularly organises information campaigns in respect of travel services available to employees, including the tax saver schemes. Posters are hung in breakrooms and staff kitchens highlighting the benefits of sustainable travel not only for the individual but also for the environment.

Personal Travel Plans

Dublin Airport is seeking to trial the roll out of Personal Travel Plans for each daa employee. The Personal Travel Plans will be based on each employee's current home address and will outline the range of travel modes available from their home address to work e.g. public transport, car sharing etc.). The aim of this initiative is to encourage the use of more sustainable travel modes by employees by outlining the impact of their decision on their carbon footprint and outlining the calorie and overall health benefits of their decision. A personal travel plan can also be linked to a car sharing site which suggests similar road users to specific employees profile at the times they wish to travel. It also allows for organising pick up times/places and suggested fee shared between the parties.

Passenger Travel Initiatives

4.4 PUBLIC TRANSPORT INVESTMENT

Dublin Airport has undertaken a series of investments aimed at improving the public transport and sustainable transport access around the campus. This has included enhanced coach parking, bus and cycle lanes and bicycle shelters, more signage and facilitating real time monitoring for bus services on the campus.

4.5 SAFEGUARDING FOR FUTURE RAIL LINKS

LOCATION OF FUTURE METRO STATION

The NTA and TII have published the Preferred Route for the north-south, high-frequency Metro Link project linking Swords, Dublin Airport, Irish Rail, DART, Dublin Bus and Luas services. This proposal was the merger of two projects, Metro North and Metro South, which have been proposed for over two decades.

The proposed new MetroLink between Dublin City Centre, Dublin Airport and Swords was announced as part of the Government's Infrastructure and Capital Investment Plan 2016-2021 and is supported by Dublin Airport as part of a suite of sustainable transport measures. It is expected that MetroLink will be the subject of a Railway Order Application to An Bord Pleanála in Q2 2020 with a view to the service being operational by 2027. On completion, the 19km line is intended to operate at a frequency of 90 seconds and will provide a journey time of 20 minutes between Dublin Airport and the city centre.

An area within the core of the airport at the Ground Transportation Centre has been preserved to facilitate a new MetroLink Station. Dublin Airport has been engaging with the NTA, TII, Dublin City Council and Fingal County Council and all other stakeholders on the project as it develops.

4.6 ELECTRIC VEHICLE CHARGING POINTS

In support of sustainable transport modes Dublin Airport has introduced a number of electric vehicles into its fleet and electrical vehicle charging points have been installed throughout the Dublin Airport campus both for staff and passenger use. In addition to existing electric vehicle charging points in the Holiday Red Car Park and in the Holiday Blue Car Park as well as the Circle K fuel station, additional charge points have been installed within the T2 multi storey car park. It is also planned to install a 100kw EV charging point (super-fast charging point) within the taxi hold area by the end of 2019.

Dublin Airport also has a target to convert its existing fleet of 111 vehicles to Low Emission Vehicle (LEV) over the next five years. The move to LEVs is part of the airport's overall sustainability strategy which includes targets based around carbon, energy, waste, water and the fleet of vehicles used on the airport campus. These initiatives will deliver a range of immediate benefits to those that work at the airport and to local communities. Around 20% of the airport's vehicle fleet have already been upgraded to LEVs and a further 5% are Hybrid vehicles.

Dublin Airport Central is implementing an initiative whereby 'preferred parking' for up to 5% of overall car parking is assigned to low emission and fuel-efficient vehicles.

4.7 SUPPORTING BUSES AND COACHES

Dublin Airport seeks to support the continued use and growth of bus use mode share, through priority bus lanes, good holding facilities, improved set down areas/coach parking. Dublin Airport supports purchase of bus tickets through the link "Buy Bus Ticket" available at the top of the Dublin Airport website landing page.

Dublin Airport has engaged with bus operators to develop new routes serving the airport and to increase frequency on existing routes. As part of a new bus tendering process and with an increased focus on mobility, Dublin Airport has introduced new incentives to encourage better connections and frequency of bus services to and from Dublin Airport, particularly during night time hours. This principal aim of this incentive is to further encourage a modal shift away from private car usage and on to public transport.

Dublin Airport has identified the top 10 areas where our staff live and also the top 4 interprovincial routes that currently are underserved in terms of bus connectivity to Dublin Airport. Dublin Airport is looking to incentivise the provision of services on such routes.

The objective of the revised bus tendering process is to:

- **Reduce private car use by providing local services that run early in the morning and late at night, facilitating shift workers at the airport;**
- **Improve uptake of public transport by passengers where possible departing from Dublin Airport during the busiest check-in time between 4.30am – 6.30am;**
- **Continue to promote high volume 24hr interprovincial services; and**
- **To improve the bussing experience through information (real time) and accessibility.**

The NTA has also confirmed plans to commence a 24hr bus service serving Dublin Airport. It is expected that the 41-route services will operate on a 24hr basis by the end of this year. This service will be particularly beneficial to staff working at Dublin Airport at times when there isn't public transport.

Sustainable Transport

As part of Dublin Airports overall Sustainability Strategy, daa aims to convert its bus operations to a low emission vehicle fleet by 2022. Trials of electric buses have recently taken place in association with Aircoach.

Dublin Airport is also in the process of undertaking a range of measures to minimise emissions both from daa vehicles and third party vehicles on the campus. Dublin Airport is also encouraging coach and bus operators to move towards lower emissions technologies, with emissions becoming a criteria for evaluation within the relevant tenders.

Dublin Airport has engaged with existing bus and coach operators to reduce emissions within existing bus set down areas. Bus drivers are being encouraged to turn their engines off as they wait kerbside at Dublin Airport. Signage has been erected in these areas to encourage bus drivers to engage with the process. The aim of this initiative is to both reduce fuel consumption and reduce the impact of the engine emissions on air quality for the passengers, visitors and staff.

4.8 REAL TIME PASSENGER INFORMATION

Real time bus information signs are a valuable asset to public transport users as guidance to the services available, their frequency and waiting times. It also shows users that public transport is being invested in and is keeping pace with technology. Work to improve access to travel data and real-time information for passengers at Dublin Airport ongoing. Improving retail time passenger information remains an ongoing programme at Dublin Airport.

Traffic Management

While not immediately obvious as an incentive for public transport usage, one of the key tasks assigned to the Landside Operations Team is to enforce transport management and traffic flow in the set down and pick up areas for public transport. This marshalling ensures busses terminate at correct locations, that they move to coach holding areas and ensures passengers are picked up and dropped off at the correct locations. It also involves organisation of the taxi holding area, to ensure that taxis go to a populated rank to reduce idling time, ensure efficient drop off and collection of taxi users. The result is to ensure a good flow of traffic in and around the terminals, to encourage efficiencies, smooth operation, quick turnaround times and good practice – all of which adds to the passenger experience.

Persons of Reduced Mobility (PRM)

Dublin Airport recognises that disabled persons and persons with reduced mobility have varying individual needs and preferences. The airport has put in place a contract to provide assistance to people with reduced mobility across the campus, with reception desks located on the departures floors of both T1 and T2 to assist users on request. Some of the other ways in which Dublin Airport seeks to meet the needs of each individual passenger, include:

- Designated set down areas on the departures road;
- PRM car park facilities in the long and short term car parks
- Facilitating a Disability Users Group, a stakeholder group intended to ensure that all future developments at Dublin Airport fully take into consideration the views of people or groups with specific needs.

5.0 ACKNOWLEDGEMENT AND AWARDS

Recognising our commitment to promoting and encouraging use of public transport and other sustainable transportation measures, Dublin Airport, through the Landside Operations Team, have been recognised for their commitment to public transport. Dublin Airport were delighted to be finalists in the NTA's Smarter Transport Workplace and Campus of the Year Award in 2017.

The Pakman Award seeks to recognise excellence in the environmental approach taken by a business, organisation or community group in all aspects of their operations. The Pakman Award is one of the highest accolades any organisation, company, community group or individual in Ireland can achieve for their environmental and sustainability efforts. The Landside Operations Team were finalists for the second successive year in 2017.

6.0 MMU OBJECTIVES

This MMU provides a good opportunity to examine the strategic objectives which were set by the 2017 update and review the success of these objectives in promoting and encouraging sustainable transport.

6.1 Review of MMU Objectives 2017 - 2019

Category	Objective	Outcome
Passenger Mode Share	• Maintain bus-based public transport mode share at 34% • Facilitate an interactive journey planning tool such as that available on journeyplanner.transportforireland.ie.	Bus-based passenger mode share was 32.2% for 2018. However, in volume terms approximately 650,000 more passengers took the bus to Dublin Airport than in 2016.
Employee Mode Share	• To maintain sustainable transport mode share (bus, cycle, walking etc.) at 25% over the next MMP period.	This continues to be achieved, with bus-based employee mode share at 29% for 2018. Dublin Airport will be trialling Personal Travel Plans for each employee with the aim of encouraging more sustainable travel modes by employees.
Improved Service and Choice	• To set up the daa Yammer* Sustainable Travel Group to disseminate information to daa employees on sustainable travel options. ** Yammer is an internal daa social networking tool* • To improve and enhance the Surface Access webpage on Dublin Airport's website for passengers wishing to access the airport by sustainable transport. • To set up a 'Dublin Airport Commuter' webpage. This will act as a dedicated page linking to lift sharing, availability of modes of transport, available discounts and links to relevant smarter travel websites for timetables, prices and purchasing discounted fares.	Achieved through the sharing of information and promotion of sustainable travel initiatives through all internal channels and a daa Dublin Airport Transport Group on Yammer. The 'To & From' section of the Dublin Airport website contains up to date information on local, regional and national bus services and also detailed information on taxi services. The 'Dublin Airport Transport Group' has been established on Yammer to share all information related to employee commuting. The trial of Personal Travel Plans for each employee will also share personal targeted information directly with each employee.
Mobility Management Schemes	• To continue to increase awareness of daa sustainable travel options through triannual information events for employees within Dublin Airport. • Prepare a Work Place Travel Plan for employees – and make it available to the top 10 employers at Dublin Airport including Dublin Airport Central.	Achieved through quarterly events and information sessions. Ongoing. Dublin Airport will be trialling Personal Travel Plans for each employee with the aim of encouraging more sustainable travel modes by employees.
Environmental/ Sustainability Initiatives	• Continue to participate the Cycle to Work Scheme and Bus TaxSaver Schemes • Facilitate at least one charging point for an electronic vehicle at the taxi holding area.	Ongoing. Bus TaxSaver participation has increased by 33% since 2016 and Cycle to Work participation has increased by 15% in the same period. Ongoing. It is planned to install a 100kw EV charging point at the taxi holding area by the end of 2019.

7.0 IMPLEMENTATION AND MONITORING

Supporting and encouraging access to Dublin Airport by a range of means is the objective of this MMU. In particular, we acknowledge that increasing awareness of sustainable transport modes is a central component of mobility management. The Landside Operations Team is responsible for overseeing and promoting the sustainable transport initiatives outlined in this MMU and ensure their delivery. The Dublin Airport Mobility Manager, with assistance from the Mobility Management Coordinator, will continue to actively oversee the implementation of the initiatives and to work with the transport authorities and operators to explore areas for further improvement.

Through our Insights Team, Dublin Airport will continue to measure performance to ensure we are on course to achieving our mobility objectives. We will monitor travel patterns through ongoing employee travel surveys, uptake of the cycle-to-work and tax saver commuter ticket schemes, as well as through annual passenger surveys.

Dublin Airport Campus Mobility Management Update
(Mobility Manager- Anthony McGarry)

- Published every 2 years
- Sets progress against targets
- Encompasses all airport activities

Dublin Airport Central Steering Group
(FCC, NTA, TII, daa, DAC-MMP lead Eoin Murray)

- Meet annually
- Review target modal splits and progress
- Agree new initiatives
- Feedback to MMU for scaling up potential

Dublin Airport Central Working Group
(Wk Grp co-ord, co-ords, DAC-MMP lead Eoin Murray)

- Support coordinators
- Meet quarterly
- Review and coordinate existing schemes being trialled across companies
- Set, agree and monitor new targets
- Liaise with Dublin Airport MMU working group inc. feedback

DAC-MMP Co-ordinator 1 (Kellogg's)

DAC-MMP Co-ordinator 2 (ESB International)

DAC-MMP Co-ordinator 3

DAC-MMP Co-ordinator 4

Dublin Airport MMU Steering Group
(MMU and amd Planning, Landside Operations Team)

- Meet annually
- MMU updated every 2 years (published)
- Red C surveys
- Metrics of progress v's targets

MMP Working Group
(MMP, daa, Third Party Operators)

- Meet bi-annually
- Meet transport operators bi-annually
- Meetings ongoing ref new routes
- Surveys ongoing for cycle to work etc...

<<<<

MMP Airport Campus Team
(Mobility Coordinator-Timea Edrei)

- Cycle to work applications
- Bus Tax Saver
- Promotion and Events for MMP
- Carpooling website
- Lockable bikes and shower facilities

NOTES

NOTES

MOBILITY MANAGEMENT UPDATE

AUGUST 2019

Appendix 10A. AQC Technical Report

Document Classification: Class 1 - General

Air Quality
CONSULTANTS

Dublin Airport North Runway:
Relevant Action Application: Air Quality Technical Report

August 2021

Experts in air quality
management & assessment

Document Control

Client	Aecom Ireland Limited	Principal Contact	Peta Donkin

Job Number	J10-12339A-10

Report Prepared By:	Ricky Gellatly and Laurence Caird

Document Status and Review Schedule

Report No.	Date	Status	Reviewed by
J10-12339A-10A/1/F5	24 August 2021	Final	Stephen Moorcroft (Director)

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1 Introduction

1.1 This Technical Report supports the air quality assessment that has been carried out within Chapter 10 of the Environmental Impact Assessment Report (EIAR). It follows on from a Technical Report (AQC Report No. J4030A/1/D4) that was prepared in 2020 to support an earlier version of the EIAR, and takes into account Requests for Information (RFI) received from Fingal County Council (FCC), the Aircraft Noise Competent Authority (ANCA) and the Irish Aviation Authority (IAA).

1.2 The assessment focuses on two pollutants with respect to potential human health effects, namely nitrogen dioxide (NO_2) and fine particulate matter (PM_{10} and $PM_{2.5}$), as these are the pollutants of greatest concern[1]. Although there are EU limit values for a range of other pollutants, there are unlikely to be any significant effects associated with emissions of benzene, carbon monoxide, sulphur dioxide or lead, and it is widely acknowledged that problems with these pollutants are only likely to arise in the vicinity of specific industrial processes none of which are relevant to the proposed Relevant Action.

1.3 There is no standard assessment approach to quantify the potential odour effects associated with airport operations. There is no published evidence to suggest that there are any physiological health effects associated with exposure to Volatile Organic Compounds (VOCs) at the concentrations at which airport odours are detectable, and the principal concern is related to nuisance or loss of amenity. A commonly-applied approach in some airport assessments is to base the odour assessment on the change in aircraft-related VOC emissions. However, there is no evidence to correlate total aircraft-related VOC concentrations with the human perception of odours. Moreover, given that airport-odours are unlikely to be related to total VOCs, any such correlation is expected to be very weak.

1.4 A variation on this general odour modelling approach was undertaken at Copenhagen Airport in 2002 (Winther et al, 2006)[2]. This study quantified odour emissions from aircraft engines using actual fuel flow and emission measurements, odour panel results, engine specific data and aircraft operational data to predict odour concentrations. Important outcomes from the study were a calculated odour emission factor from the aircraft engines of 57 Odour Units (OU_E) per milligramme of hydrocarbon, and the identification that the majority of the odorous emissions (97%) occurred whilst aircraft engines were running at idle. Odour emission factors from the Copenhagen study have been used in this assessment. Hydrocarbon emissions have been quantified from aircraft

1 Department for Transport (2006), Project for the Sustainable Development of Heathrow (PSDH). EPA (2015), *Air Quality In Ireland* also notes that no levels above the EU limit values were reported at any network monitoring site in 2015, but that Ireland faces challenges in reducing levels of particulate matter, and in maintaining compliance with the limit value for nitrogen dioxide, particularly in urban areas.

2 Winther M, Kousgaard U and Oxbol A (2006), Calculation of odour emissions from aircraft engines at Copenhagen Airport. Sci Tot Env, 366, 218-232

operations in idle mode using the approach outlined above. An odour emission rate of 57 OU_E/mg-HC has then been applied.

1.5 The permitted operation scenario assumes that the North Runway is operational but the airport is constrained by the restrictions on night-time use of the runway system at Dublin Airport, namely the restriction on the number of flights permitted between the hours of 1100 hrs and 0700 hrs which limits the daily number of flights to 65 between these hours and the restriction of the use of North Runway at night (no use 2300 hrs to 0700 hrs) (i.e. conditions no. 3 and no. 5). This is the default scenario which will occur once the North Runway becomes operational, if the Relevant Action is not approved.

1.6 The proposed operation scenario assumes that the Relevant Action is in place, the North Runway is operational, but the airport is not constrained by the restrictions on night-time use of the runway system at Dublin Airport. Instead, the North Runway is used in the shoulder hours 0600 hrs to 0700 hrs and 2300 hrs to 0000 hrs and a Noise Quota system replaces the 65-daily number of flights restriction.

1.7 A detailed emissions inventory, taking account of all relevant Airport sources and the landside road network has been compiled; the emissions have then been input to a dispersion model to predict future changes to baseline air quality for permitted operations. A similar approach has been adopted to predict the changes in pollutant concentrations associated with the proposed operations, and the likely significance of these changes determined with regard to established approaches. The assessment takes into account all relevant national policies and guidance, specifically with regard to the Advice Notes issued by EPA (EPA, 2015)[3] and Technical Guidance TG16[4] issued by the Department for Environment, Food and Rural Affairs (Defra) in the UK. The UK guidance is used in the absence of specific Irish Guidance.

1.8 This assessment has used the same Defra tools as detailed in the original Technical Report. Defra published new tools in August 2020, which supersede the versions used in the original assessment. The tool updates include revised vehicle emissions factors and an updated $NOx:NO_2$ calculator. The EFT update principally involves revised vehicle fleet projections to account for a more rapid uptake of electric hybrid and battery electric vehicles, as well as adoption of the latest COPERT 5.3 emissions factors. The updated $NOx:NO_2$ calculator incorporates revised regional background NOx components and updated primary NO_2 assumptions. A review of the outputs from these tools compared to the previous versions as used in the original assessment, demonstrates that the changes result in very minor differences in emissions and concentrations, which are generally lower using the latest tools. It was, therefore, decided to use the original tools for consistency with the previous studt, and as this is slightly conservative in comparison to use of the

3 EPA (2015), Advice Notes for Preparing Environmental Impact Statements, Draft, September 2015.

4 Defra (2016), LAQM Technical Guidance TG16. Available at http://laqm.defra.gov.uk/supporting-guidance.html. (There is no equivalent guidance in Ireland).

latest tools. The use of the original Defra tools will not affect any conclusions of the assessment work.

2 Air Quality Model

2.1 The predictions have been carried out using atmospheric dispersion modelling. This section describes the various assumptions and input data that were used to compile the emissions inventory and the dispersion model set-up.

2.2 Predictions of nitrogen dioxide, PM_{10} and $PM_{2.5}$ concentrations have been carried out for the Model Baseline year (2018)[5] and the Predicted Assessment years 2022, 2025 and 2035 for the permitted and the proposed operations at sensitive receptors. Predictions have also been carried out to quantify potential odour effects from aircraft operations. The proposed runway use is as described in Chapter 2 of the EIAR.

2.3 A summary of the scenarios considered is as follows:

- Permitted Scenario (2022) has no Northern Runway in operation 2300 to 0700
- Proposed Scenario (2022) has no Northern Runway in operation 0000 to 0600, and Segregated Mode 0600-0700 and 2300-0000
- Permitted Scenario (2025) has no Northern Runway in operation 2300 to 0700, and Mixed Mode departures 0700-0900
- Proposed Scenario (2025) has no Northern Runway in operation 0000 to 0600, Mixed Mode departures 0600-0800, and Segregated Mode 2300-0000
- Permitted Scenario (2035) has no Northern Runway in operation 2300 to 0700, and Mixed Mode departures 0700-0900
- Proposed Scenario (2035) has no Northern Runway in operation 0000 to 0600, Mixed Mode departures 0600-0800 and Segregated Mode 2300-0000

2.4 The predictions have been carried out using the Atmospheric Dispersion Modelling Software ADMS-Airport model. This model incorporates a jet module specifically designed to represent the dispersion of emissions from moving aircraft and was selected by the UK Department for Transport's expert advisory panel (Project for the Sustainable Development of Heathrow) for use on third runway studies at Heathrow Airport[6]. It is also the model that was selected by the UK Airports Commission to evaluate the increase in runway capacity in South-East England[7] and has been used in previous studies at Dublin Airport.

[5] The Model Baseline year is used to verify the performance of the model and need to be based on a full calendar year for which activity data (e.g. aircraft movements), monitoring data and meteorological data are available.

[6] Department for Transport (2006), Project for the Sustainable Development of Heathrow.

[7] Airports Commission (2015), Final Report, July 2015.

2.5 The model requires the user to provide a variety of input data which describe pollutant emissions arising from Airport-related sources (both airside and landside), the meteorological conditions, and the background contribution (i.e. the contribution to pollutant concentrations from sources not explicitly included in the model).

2.6 Pollutant concentrations arise from a number of Airport-related sources, and the following were taken into account in this assessment:

- Aircraft main engines operating within the Landing and Take-off (LTO) Cycle and the use of aircraft Auxiliary Power Units (APUs);
- Ground Support Equipment (GSE) including airside vehicles and Mobile Ground Power Units;
- Airport energy plant; and
- Road traffic on the local road network.

2.7 Emissions on the roads leading to the car parks have been included in the assessment. Other Airport sources, such as ground-run engine testing, fire training, and Airport car parks have not been included, as their contribution to ground-level pollutant concentrations is minor as the emissions are very small.

2.8 The approach to quantifying emissions from the Airport sources has been based on accepted methodologies used for many other airport studies, and follows, as far as practicable, the "sophisticated or advanced approach" recommended by the International Civil Aviation Organization (ICAO) in its Airport Air Quality Manual[8]; the ICAO manual is focussed on the assessment of existing airport operations and does not include guidance on how future operations might be considered.

Aircraft Operations – Landing and Take-off (LTO) Cycle

2.9 The emissions arising from each aircraft movement have been calculated as the sum of the emissions for each part of the LTO cycle. Records of 2018 Model Baseline year aircraft mix and numbers of aircraft movements were provided by daa[9]. Forecast movements and aircraft mix for all future scenarios were also provided by daa[10]. A summary of the aircraft data used in this assessment is provided in Appendix A1.

2.10 All turbofan-type aircraft jet engines with a rated power greater than 26.7 kN are certified by the ICAO for emissions of NOx, HC and Smoke Number. In addition, a database of emissions indices for all commercially operational turboprop aircraft engines is kept by the Swedish Defence

8 ICAO (2016), Airport Air Quality Manual – CAEP10 Steering Group Approved Revision.

9 Annual aircraft movements by operator for 2018 published in Bickerdike Allen Partnership EIA Aircraft Noise and Vibration Assessment Assumptions Report.

10 Forecast movements for 2022, 2025 and 2035 provided by daa for Permitted Operations and Proposed Operations published by Bickerdike Allen Partnership.

Research Agency (FOI). For each type of aircraft, emissions per aircraft movement have been calculated using emission factors in grammes of pollutant per kilogram of fuel burnt, together with fuel flow in kilogrammes per second, based on Equation [1]:

$E_{ij} = \sum (TIM_{jk}*60) * (FF_{jk}) * (EI_{jk}) * (NE_j)$ Equation [1]

Where:

E_{ij} = Emissions of pollutant i in grammes, produced by aircraft type j for each LTO cycle;

TIM_{jk} = Time-in-mode for mode k (e.g. idle, approach, climb-out or take-off) in minutes for aircraft type j

FF_{jk} = Fuel flow for mode k (e.g. idle, approach, climb-out or take-off) in kg/sec for each engine on aircraft type j

EI_{jk} = Emissions index for each pollutant i in grammes per kilogram of fuel, in mode k, for each engine used on aircraft type j

NE_j = Number of engines on aircraft type j

2.11 The emissions indices have been obtained from the ICAO Engine Exhaust Emissions Databank[11]. Airframe/engine assignments were based on information provided by Aer Lingus and Ryanair for common aircraft types such as the Boeing 737-800 and the Airbus A320, which represent the majority of the movements; default airframe/engine assignments were used in other cases.

2.12 Smoke number emissions indices are not available for all aircraft engines in all of the four ICAO standard thrust settings (100%, 85%, 30% and 7%). Where Smoke Number indices for an engine in a particular mode or modes are missing from the ICAO databank, the Smoke Number indices have been estimated based on the maximum Smoke Number for the engine, and the recommended scaling factors presented in Table D-1 of the ICAO Airport Air Quality Manual.

2.13 The ADMS-Airports model takes into account the heat and momentum flux, and the pollutant emission rate, which varies for each certified engine. It is impractical to treat each airframe/engine combination separately, and so the aircraft have been assigned into a number of "modelling categories" (MCATs). For the 2018 Model Baseline year, the aircraft were assigned into "groups" of similar characteristics (e.g. numbers of engines, engine types, engine mounting and wake category) with a "lead" aircraft selected to represent each group. These group assignments are shown in Appendix A1, Table A1.2. The emissions, and input parameters for the ADMS-Airport model, were then based on the assumption that the total number of movements within each group was represented by the lead aircraft. For the future year scenarios, MCATs were determined for future airframe/engine combinations using the same methodology as for 2018, by taking account of

11 ICAO (2019) Engine Exhaust Emissions Databank, [Online]: https://www.easa.europa.eu/domains/environment/icao-aircraft-engine-emissions-databank

engine exhaust buoyancy flux and NOx emissions, as well as the forecast proportion of total annual ATMs (see Appendix A1, Table A1.3).

2.14 The approach used for the estimation of PM emissions arising from aircraft engines has undergone development in recent years. The original approach, based on the ICAO reported maximum Smoke Number, only estimated the non-volatile fraction of PM. To address this problem, the contribution of PM emissions from the volatile fraction was considered by a CAEP Working Group, and a First Order Approximation (FOA) method was derived; this approach estimates the non-volatile portion using the ICAO Smoke Number, but also estimates the volatile portion associated with the fuel sulphur content, fuel-based organics and lube oil. Version 3 of the FOA is now available (FOA v3.0) and is the approach recommended in the ICAO Airport Air Quality Manual. The FOA v3.0 approach has been used to estimate aircraft engine PM emissions.

2.15 Recent research comparing the FOA v3.0 approach with measurements has identified a discrepancy in both the organic carbon and black carbon emissions indices (Stettler et al, 2011)[12]. Combined, these discrepancies result in a 3.4 factor underestimate of total $PM_{2.5}$ emissions. Accordingly, to account for this potential uncertainty, the FOA v3.0 emissions indices for PM (both PM_{10} and $PM_{2.5}$) have been factored up by 3.4.

2.16 In future years, it is expected that the aircraft fleet will be modernised. Mott MacDonald have prepared a report on the expected modernisation of the fleet which has been taken into account in all future year assessments[13]. A summary of the expected modernisation programme is set out in Table 1.

Table 1: Expected Aircraft Fleet Modernisation Programme

Current Aircraft Type	Modernised Aircraft Type
Airbus A320	Airbus A320neo
Airbus A321	Airbus A321neo
Airbus A330	Airbus A330neo
Boeing 737-800	Boeing 737-8 Max
Boeing 777	Boeing 777X
Embraer E190/E195	Embraer E190-E2

2.17 The fleet forecasts for the future assessment scenarios show very limited penetration of the Airbus A330neo, Boeing 777X and Embraer E190-E2 aircraft into the Dublin Airport fleet. The relatively small number of movements of these aircraft in future scenarios (<4% of total ATMs) will have little effect on overall emissions from aircraft activity, and therefore for simplicity, the Airbus A330neo and Boeing 777X have been included in an MCAT led by the Boeing 787, which has a very high

12 Stettler, M.E.J, Eastham, S and Barrett, S.R.H. (2011). Air quality and public health impacts at UK airports. Part 1: Emissions. *Atmos Environ* 45, 5415-5424.

13 Dublin Airport Fleet Modernisation Analysis. Mott MacDonald. April 2019.

occurrence in the future forecasts, with similar engine emissions to the A330neo and B777X. The Airbus A320neo and A321neo and Boeing 737-8 Max are all expected to fly frequently from Dublin Airport in the future scenarios, and so have been included in the model as individual MCATs. Engine emissions data for these aircraft have been obtained from the ICAO emissions databank, as although not all were operating from Dublin Airport in 2018, their engines have now been certified by ICAO and emissions data are available.

2.18 The International Civil Aviation Organisation (ICAO) has defined a specific LTO cycle with four modal phases, extending to a ceiling height of 3,000 feet (915 metres). Emission factors are provided for TO: 'take-off' (100% thrust), CO: 'climb-out' (85% thrust), AP: 'approach' (30% thrust) and ID: 'idle' (7% thrust). In reality, aircraft rarely take-off at 100% thrust - the actual take-off thrust used being dependent on a combination of factors including take-off weight and weather conditions. Following discussion with daa, a take-off thrust of 100% was used for all aircraft departures, but is likely to represent a worst-case assumption.

2.19 Take-off roll along runway, and initial climb to 1500ft (457.5m) was assumed to be at 100% thrust setting. Climb-out after throttle back from 1500-3000ft (457.5-915m) was assumed to be at 85% thrust.

2.20 The majority of commercial jet aircraft operating at Dublin Airport have reverse thrust capability, which may be deployed during landing to increase the rate of deceleration. However, the Airport discourages the use of reverse thrust at night-time, and the airlines also try to avoid the use of reverse thrust to minimise fuel consumption. As a result, only a very small number of aircraft movements at the Airport are expected to utilise reverse thrust above idle during landing (related to unfavourable weather conditions[14]). The assumption used in the modelling has therefore been that aircraft engine thrust is reduced to idle (7%) for landing roll-out (i.e. from the point of touchdown on the runway to the start of taxi); emissions from the small number of aircraft using reverse thrust above idle has been discounted as they will make an insignificant contribution to total runway emissions.

2.21 Emission factors within the ICAO and FOI databases are usually stated for new engines. Based on PSDH recommendations to account for engine deterioration, NOx emissions have been increased by 4.5% while, for PM_{10}/$PM_{2.5}$, the fuel flow and subsequent calculation of emissions has been increased by 4.3%.

2.22 Times-in-mode for take-off, approach and climb-out have been derived from information provided by daa[15].

2.23 The take-off and climb-out profiles (times/speeds/angle of climb) have been estimated from flight data provided by Ryanair for a B737 take-off at Dublin Airport[7]. The B737 is the most common

14 This was confirmed by Aer Lingus in a Request For Information (R15100_002_050)

15 Ryanair flight data derived from the Boeing Climb Out Programme

aircraft type currently in operation at Dublin Airport, and these parameters have been assumed to apply to all other aircraft types (emissions during climb out will contribute very little to ground-level pollutant concentrations, and this assumption will not affect the outcome of the assessment).

2.24 The approach angle (3 degrees) was confirmed by daa, with the approach time based on information published for the Stansted Airport G2 assessment[16] for medium sized aircraft (246 seconds). Approach speeds were calculated from the correlation between approach times and distances. The horizontal approach distance was calculated from vertical descent ceiling (915 m) and the angle of approach (3 degrees) using trigonometry.

2.25 For the future assessment scenarios in 2022, 2025 and 2035 the same take-off, climb-out and approach profiles as used in the 2018 baseline have been assumed.

2.26 The roll out distance (i.e. distance from wheels down to start of taxi) has been estimated based on the distance measured between the visible runway landing marks and the main high-speed taxiway exit on each runway. Aircraft were assumed to be operating at idle thrust (7%) during roll out (landing roll).

2.27 For the 2022, 2025 and 2035 assessment scenarios, the roll-out distance on the north runway has been assumed to be the same as on the existing south runway. The assumed distance was assumed to remain unchanged between 2018 Model Baseline and the assessment years.

2.28 For ground operations, data were obtained from the daa movement database, which tracked the arrival and departure times of all aircraft during 2015. Analysis of these data has allowed a number of parameters to be estimated, including the taxi times between the different stand groups and runways, and the departure delay (aircraft hold) time.

2.29 Departure delay (i.e. the delay to aircraft between push back from stand and take off from runway) was assumed to be located at runway end (in a hold queue). Emissions from aircraft during departure delay (assumed to be at idle mode (7%)) were modelled as a volume source located at the taxiway at the end of each runway. A source depth of 5 metres, with a centre height of 3.5 metres was assumed for the emissions from the main engines, to account for the physical height of the engine and initial plume buoyancy due to the heat of the exhaust. This is the case for all model assessment years.

2.30 For the assessment years of 2022, 2025 and 2035 taxi times to and from the south runway were assumed to be unchanged from 2018. For the north runway, taxi times from each of the stand groups was estimated, based on the distance between the stands and runway ends/runway exits and the average speed of taxiing aircraft obtained from the 2018 movement data (i.e. it was assumed that aircraft will taxi to and from the north runway at the same speed as to/from the south runway).

16 Stansted G2 Air Quality Assessment Methodology AEAT/ENV/R/2497/Issue 1 May 2008

2.31 The departure delay in 2022, 2025 and 2035 was assumed to be the same as for the south runway in 2018; for the north runway, the average 2018 departure delay was applied to all aircraft using the north runway. This represents a conservative assumption.

2.32 Emissions during climb-out and approach have been calculated to a ceiling height of 915 metres (3,000 feet).

2.33 All approach and departure (climbout) routes have been assumed to coincide with the extended centreline up to the ceiling height of 915m. For departures, when the two runways are both in operation, departure routes known as Scenario B will be used. Under this scenario, there will be straight-out departures on the South runway, but a 15°N divergence for easterly departures on the North Runway and a split divergence of 30°N and 75°N for westerly departures on North Runway, depending on the ultimate destination of aircraft. IAA has confirmed that the minimum altitude for the initiation of divergence will be 120m, but in practice, aircraft will normally be at a height of between 300-500m before starting the turn. Emissions from aircraft at these altitudes will have no discernible impact on ground-level pollutant concentrations, and the straight-line departure routes assumed in the model will not affect the outcome of the assessment.

Aircraft Operations – Brake & Tyre Wear

2.34 An allowance has also been made for PM emissions arising from brake and tyre wear based on a methodology developed during the PSDH work[17]. For brake wear, an emission factor of 2.51×10^{-7} kg PM_{10} per kg Maximum Take-off Weight (MTOW) was assumed. For tyre wear, the following relationship in equation [2] was used:

PM_{10} (kg) per landing = 2.23×10^{-6} x (MTOW kg) – 0.0874 kg Equation [2]

2.35 Emissions were calculated for all large aircraft. The relationship is not applicable to smaller aircraft, below 55,000 kg, and it was assumed the PM emissions from tyre wear follow a linear relationship between MTOW = 55,000 kg to MTOW = 0 kg.

Aircraft Operations - Auxiliary Power Units

2.36 Auxiliary Power Units (APUs) are used to provide power to larger aircraft when the main engines are not running. APUs are used to condition the aircraft cabin when temperatures are uncomfortable. Other requirements for APU use occur if there is an incompatibility between the aircraft system and the Mobile Ground Power Unit (MGPU) supplies, or if there is a technical fault.

2.37 Typical APU run times have been based on information provided by daa and were assumed to be 5 minutes on arrival on stand, and 10 mins prior to departure (push back from stand), for all aircraft movements.

17 Curran (2006). Method for estimating particulate emissions from aircraft brakes and tyres. Qinetic Q/05/01827

2.38 APUs operate in three different modes, i.e. Start-up, Normal Running (ECS – Environmental Control Systems) and MES (Main Engine Start). On arrival, it was assumed that the APU operates in Start-up mode for 3 minutes, and in ECS for 2 minutes. On departure, it was assumed that the APU operates for 3 minutes in Start-up mode, for 6.5 minutes in ECS, and for 30 seconds in MES mode. The emissions indices for each mode have been derived from TRB's Airports Cooperative Research Programme Report - ACPR 64[18] (Table 2).

2.39 For the assessment years, the arrival and departure APU run times were assumed to be unchanged from 2018. This is likely to represent a conservative assumption if a policy to restrict APU run times is implemented and/or FEGP is installed.

2.40 The ACPR report does not provide information on PM emissions from APU operations. Emission rates for PM have been based on a function of the corresponding NOx emission factor ($PM = 0.0233*NOx^{0.0934}$)[19].

Table 2: APU Emission Indices in grams per second (g/s)

Airframe Type	Start Up			ECS			MES		
	NOx	PM	HC	NOx	PM	HC	NOx	PM	HC
Narrow Body	0.11	0.03	0.14	0.23	0.02	0.01	0.29	0.02	0.01
Wide Body	0.26	0.03	0.03	0.57	0.02	0.01	0.74	0.02	0.01
Jumbo Wide Body	0.24	0.03	0.03	0.63	0.02	0.01	0.65	0.02	0.01
Regional Jet	0.07	0.03	0.02	0.09	0.02	0.01	0.10	0.02	0.01
Turbo Prop	0.07	0.03	0.02	0.09	0.02	0.01	0.10	0.02	0.01

Airside Vehicles and Mobile Ground Power Units (GSE)

2.41 Emissions from airside vehicles are associated with the transport of passengers and cargo to aircraft, and servicing and refuelling of aircraft, etc. MGPUs provide auxiliary power for aircraft, when necessary. Collectively, these are referred to a Ground Support Equipment (GSE). Detailed information on GSE (including size and type of engine) is not available at Dublin Airport; the approach taken has been to scale emissions from other airports where detailed emissions inventories of airside vehicles have been compiled. A summary of the data compiled is shown in Table 3 and Table 4; the data are summarised as emissions of NOx/PM_{10} (tonnes) per mppa.

18 Handbook for Evaluating Emissions and Costs of APUs and Alternative Systems. ACPR – 64. Available at 6) http://www.trb.org/Publications/Blurbs/167070.aspx

19 AEA (2008) Stansted G2 Air Quality Assessment Methodology AEAT/ENV/R/2497/Issue 1

Table 3: Comparison of GSE NOx Emissions

Airport	GSE NOx Emissions (tpa)	mppa	Year	NOx Emissions/mppa (tpa)
London City	5.3	3.65	2014	1.45
London Luton	27.7	9.51	2011	2.91
London Gatwick	76.9	32.36	2009	2.38
London Heathrow	266.9	65.91	2009	4.05

Table 4: Comparison of GSE PM_{10} Emissions

Airport	GSE PM_{10} Emissions (tpa)	mppa	Year	PM_{10} Emissions/mppa (tpa)
London City	0.29	3.65	2014	0.08
London Luton	1.56	9.51	2011	0.16
London Gatwick	4.17	32.36	2009	0.13
London Heathrow	18.33	65.91	2009	0.28

2.42 Operations in 2018 at Dublin Airport (~31.5 mppa) are close to those at London Gatwick Airport in 2009 (~32 mppa). The profile of operations at London Gatwick Airport is broadly similar to that at Dublin Airport, with both airports predominated by short-haul flights with a high proportion operated by low-cost carriers, and both operate with single runway operation. London Gatwick has a higher proportion of long-haul flights, but this is unlikely to significantly affect GSE emissions. The GSE emissions at Dublin Airport in 2018 have therefore been calculated by scaling the GSE emissions from Gatwick by mppa.

2.43 For the assessment years, the GSE emissions were scaled up from the 2018 emissions, based on the ATM ratios for the various scenarios. The approach is based on the assumption that the amount of GSE required to service the airport will increase in line with the number of aircraft arriving and departing. This represents a conservative assumption as it does not take account of fleet rollover and the introduction of lower and zero-emission vehicles and plant into the fleet.

Road Traffic

2.44 Emissions arising from traffic on the local road network have been calculated using the ADMS-Roads (v5.0) dispersion model. Predictions are based on vehicle flow, composition and speed using the same emission factors published within the Emission Factor Toolkit (EFT, version 9.0). The emission rates account for emissions of PM_{10} and $PM_{2.5}$ arising from brake and tyre wear and from road abrasion. Whilst PM emissions from entrainment (or "re-suspension") of other materials on the road are also widely considered to be important, there are currently no data upon which robust emission rates can be calculated; any re-suspension component has therefore been necessarily ignored.

2.45 Annual average daily traffic (24 hr-AADT) flows, the proportions of Heavy Duty Vehicles (HDV) and average speeds for each road link were provided by AECOM for 2019 and the 2022, 2025, and 2035 assessment years; the 2019 flows were adjusted to the 2018 Existing Environment year by factoring, using historic traffic count data (as advised by AECOM). The assumed flows are summarised in Appendix A.

2.46 European type approval ('Euro') standards for vehicle emissions apply to all new vehicles manufactured for sale in Europe. These standards have, over many years, become progressively more stringent and this is one of the factors that has driven reductions in both predicted and measured pollutant concentrations over time.

2.47 Historically, the emissions tests used for type approval were carried out within laboratories and were quite simplistic. They were thus insufficiently representative of emissions when driving in the real world. For a time, this resulted in a discrepancy, whereby nitrogen oxides emissions from new diesel vehicles reduced over time when measured within the laboratory, but did not fall in the real world. This, in turn, led to a discrepancy between models (which predicted improvements in nitrogen dioxide concentrations over time) and measurements (which very often showed no improvements year-on-year).

2.48 Recognition of these discrepancies has led to changes to the type approval process. Vehicles are now tested using a more complex laboratory drive cycle and also through 'Real Driving Emissions' (RDE) testing, which involves driving on real roads while measuring exhaust emissions. For Heavy Duty Vehicles (HDVs), the new testing regime has worked very well and NOx emissions from the latest vehicles (Euro VI) are now very low when compared with those from older models[20].

2.49 For Light Duty Vehicles (LDVs), while the latest (Euro 6) emission standard has been in place since 2015, the new type-approval testing regime only came into force in 2017. Despite this delay, earlier work by AQC showed that Euro 6 diesel cars manufactured prior to 2017 tend to emit significantly less NOx than previous (Euro 5 and earlier) models.

2.50 AQC has analysed trends in measured NOx concentrations against trends in Defra's EFT model predictions for the period 2013 to 2019[21]. This has demonstrated that, while the EFT typically over-stated the improvements over the period 2013 to 2016, it has tended to under-state the improvements since 2016. Wider consideration of the assumptions built into the EFT suggests that, on balance, the EFT is unlikely to over-state the rate at which NOx emissions decline in the future at an 'average' site in the UK. In practice, the balance of evidence thus suggests that NOx concentrations are most likely to decline more quickly in the future, on average, than predicted by the EFT, especially against a base year of 2016 or later. Using EFT v9.0 for future-year forecasts

20 ICCT (2017) NOx emissions from heavy duty and light duty diesel vehicles in the EU: Available at: www.theicct.org/nox-europe-hdv-ldv-comparison-jan2017

21 AQC (2020) Performance of Defra's Emission Factor Toolkit 2013-2019. Available at www.aqconsultants.co.uk

in this report thus provides a robust assessment, given that the model has been verified against measurements made in 2018.

Stationary Sources

2.51 An inventory of combustion plant in use at Dublin Airport was provided by daa. This includes a list of plant type (CHP, generator or boiler), size (in MW) and fuel type (gas or oil-fired). The inventory also includes annual gas and oil fuel use by total usage (i.e. not attributed to individual plant). The emissions per annum across all plant have therefore been calculated from the total annual fuel use of gas and oil, based on NOx and PM emissions indices from the EEA/EMEP Guidebook 1.A.4 Table 3-8 and Table 3-9[22].

2.52 The assumed emissions indices are:

- Gas NOx = 74 g/Gj;
- Oil NOx = 306 g/Gj,
- Gas PM_{10} = 0.78 g/Gj and
- Oil PM_{10} = 21 g/Gj.

2.53 daa also provided a map of the locations of these combustion sources. The very large (>1MW) plant are located in one of two main energy centres; one in Terminal 1 (EC1) and one in Terminal 2 (EC4), and these represent the majority of the capacity. For these energy centres, daa provided specific information on stack heights. All stationary source emissions were assumed to be emitted from EC1 and EC4, with the emissions apportioned, based on the total combined size of plant in each energy centre (23.3 MW in EC1 (43%) and 31.3 MW in EC4 (57%).

2.54 The exit velocity was assumed to be 15 m/s in accordance with best practice for large combustion plant. The exit temperature was assumed to be 120 degrees C in line with typical CHP plant, but acknowledging that exhaust temperatures from the boilers will be typically lower (~65 deg C) and from generators much higher (~400+ deg C). Stack diameters have been estimated based on observations from Google satellite imagery. The assumed parameters are:

EC1 – terminal 1: Stack Height = 30 m, diameter = 1 m

EC4 – terminal 2: stack height = 39 m, diameter = 2.5 m

2.55 The combustion plant inventory provided by daa is for 2015. For the 2018 baseline assessment, it has been assumed that gas and oil consumption in the daa boilers and CHP plant are the same as they were in 2015. For the future assessment years, the emissions from stationary sources were estimated by scaling up the 2018 emissions based on the forecast ATM ratio in each scenario, in

22 EMEP/EAA Emission Inventory Guidebook (2019). Available at https://www.eea.europa.eu/publications/emep-eea-guidebook-2019

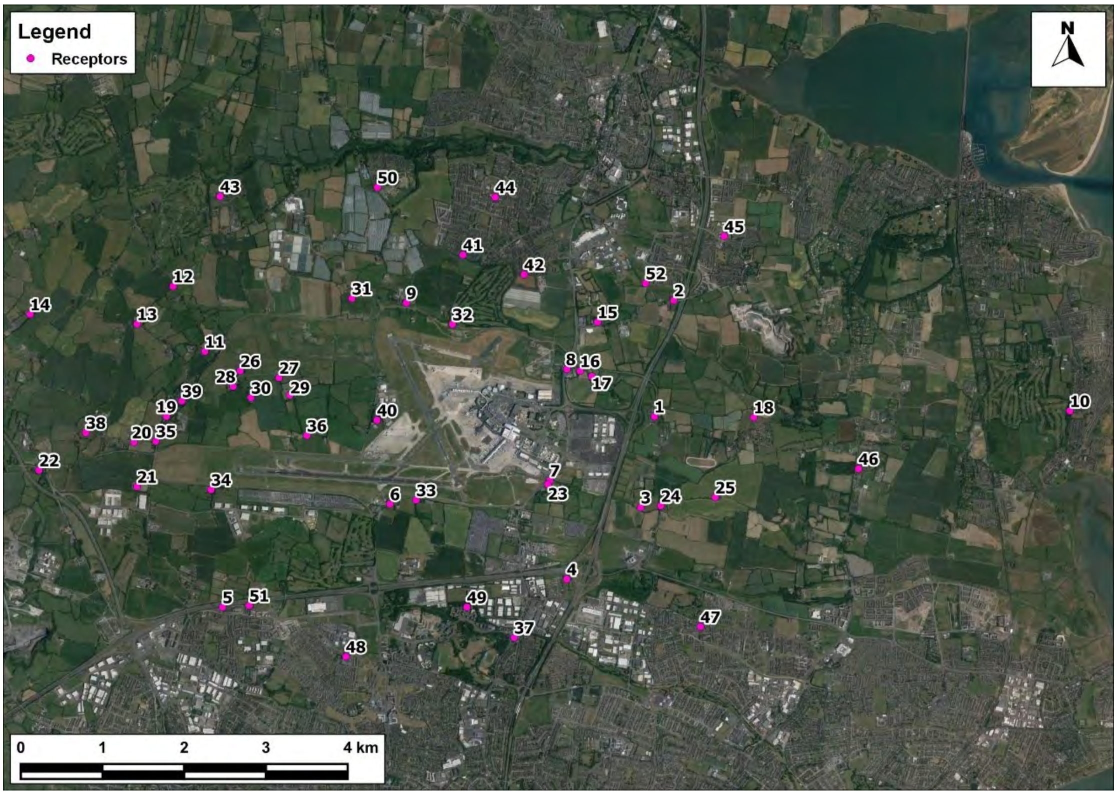
line with the assumptions for GSE. This is likely to represent a conservative assumption as it does not take account of any incremental energy efficiency measures that will reduce the airport's heating demand in future years. The emissions release parameters were assumed to be the same as for 2018, and the apportionment of emissions between EC1 and EC4 unchanged.

3 Definition of Study Area and Receptors

3.1 The geographical study area for Air Quality is outlined in Figure 1. The study area is effectively defined based on the approach to quantifying emissions from the Airport sources as recommended by the ICAO in its *Airport Air Quality Manual*[23], taking into account a geographical area where there is a potential for a change in air quality with the proposed operations and the extent of the road transport network considered.

3.2 The contribution that airport-related emissions make to local air quality reduces with increasing distance from the airport boundary. It should be noted that aircraft at 1000m altitude will make no contribution to ground level pollutant concentrations, and the contribution of Airport sources beyond 1km will not be discernible.

Figure 1: Air Quality Assessment Study Area and Receptors



3.3 The NRA guidance defines sensitive receptors as locations including residential housing, schools, hospitals, places of worship, sports centres and shopping areas, i.e. locations where members of the public are likely to be regularly present. Sensitive receptors within the study area (e.g. dwellings, schools, hospitals etc.) have been identified.

23 ICAO (2016),Airport Air Quality Manual, available at http:www.icao.int

3.4 The specific receptor locations identified for the air quality assessment are shown in Figure 3. In selecting these receptors, consideration has been given to locations that may be affected by the permitted North Runway, once it becomes operational. These receptors include residential properties close to the airport and/or under flight paths as well as specific locations such as schools and community facilities. A specific receptor was also included in Portmarnock (at Ardilaun, at the eastern boundary of Malahide Golf Club), some 7km to the east of the Airport (which represents the closest residential properties in Portmarnock to the Airport). In some instances, a single receptor location has been selected to represent a group of residential properties, as the predicted concentrations would tend to be similar within the cluster of properties.

3.5 In addition to these receptors for the Air Quality Assessment, pollutant concentrations have been predicted across a much wider study area to support the Health Impact Assessment. These receptor locations are consistent with the noise modelling work undertaken by Bickerdike Allen Partners (BAP) and the coordinates for all existing and permitted receptors were provided by BAP.

4 Meteorological Data

4.1 Hourly sequential meteorological data[24] for 2018 were obtained from the Met Eireann station at the Airport; the wind rose is shown in Appendix A2.

4.2 Runway use at the Airport is determined by weather conditions. Currently, Runway 28 (westerly) is the preferred runway, with 71.4% of departures and 72.2% of arrivals in 2018; however, when the wind direction is from the east, Runway 10 (easterly) is used. The Airport provided details of runway allocation for each departure and arrival. These data showed a strong correlation demonstrating that during easterly wind conditions (between 0 degrees and 180 degrees), aircraft operated from Runway 10, whereas during westerly wind conditions (between 180 degrees and 360 degrees), aircraft operated from Runway 28. Therefore, in the ADMS-Airport model, runway allocation has been determined by wind direction. During hours where winds occur in the sectors 0 - 180º, Runway 10 is assumed to be in use, and sources using Runway 28 are “switched off”. During hours with winds occurring in the sectors 180 – 360º, Runway 28 is assumed to be in use and sources using Runway 10 are “switched off”.

4.3 A similar approach to switch between Runways 28R/28L and 10R/10L was used in all future year scenarios.

[24] The ADMS Airport model considers the hour-by-hour meteorological conditions across the 8760 hours in the year. It is not possible to use long-term statistical datasets in the model.

5 Background Concentrations

5.1 The ADMS Airports model predicts pollutant concentrations from those sources of emissions that have been explicitly included in the model. It is also necessary to take account of the contribution from other pollutant sources that are not explicitly included – normally referred to as the "background contribution".

5.2 Background pollutant concentrations have been defined from local monitoring data. For nitrogen dioxide, an annual mean concentration of 16 µg/m^3 was assumed for 2018 based on measured concentrations in 2018 at the Swords monitoring site, operated by EPA. For PM_{10}, an annual mean concentration in 2018 of 11 µg/m^3 was assumed, based on concentrations measured at the Phoenix Park monitoring site.

5.3 There are only limited data to describe $PM_{2.5}$ concentrations. The approach taken to estimate $PM_{2.5}$ concentrations was to use the UK Government's background pollutant concentrations maps[25] to calculate the average ratio between PM_{10} and $PM_{2.5}$ concentrations across the whole of Northern Ireland (mapped background data are not available for the ROI) and apply this ratio to the measured PM_{10} background concentration at Phoenix Park. This provides an estimated 2018 background $PM_{2.5}$ concentration of 6.8 µg/m^3.

5.4 Background pollutant concentrations are expected to decline in future years due to a range on national and international measures to reduce emissions across a wide range of sources. Background concentrations in 2022, 2025, 2035 were determined based on the approach recommended by the Transport Infrastructure Ireland (formerly the National Roads Authority[26]). This involves calculating the average pollutant concentration across all 1 x 1 km Defra background map squares in Northern Ireland for the Model Baseline (2018) year and the assessment years[25] and then calculating the ratio in the average NO_2, PM_{10} and $PM_{2.5}$ concentration between baseline and future years. The ratios were then applied to the background concentrations described above, to estimate the future year background concentrations. The background concentrations used in the assessment are shown in Table 5.

25 The Defra 1 x 1 km maps only extend to 2030. Background concentrations have been assumed to remain unchanged between 2030 and 2035 which is a conservative approach.

26 NRA (2006) Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes. Revision 1 issued on 8 May 2011.

Table 5: Background Concentrations (µg/m^3)

Pollutant	Year			
	2018	2022	2025	2035
Nitrogen Dioxide	16.0	13.7	12.4	11.6
PM_{10}	11.0	10.5	10.2	10.1
$PM_{2.5}$	6.8	6.4	6.1	6.0

6 NO_x to NO_2 Relationship

6.1 Nitrogen dioxide (NO_2) concentrations have been calculated from the predicted NOx concentrations using the 'NO_2 from NOx calculator' available on the Defra air quality website[27]. This calculator requires an estimate of the proportion of primary NO_2 (f-NO_2). This was calculated individually for each receptor based on the relative contribution of different sources to total locally-generated NOx concentrations. For road vehicles, representative values of f-NO_2 are contained within the 'NO_2 from NOx calculator'. For aircraft, f-NO_2 values obtained from the National Atmospheric Emissions Inventory were used[28]. For all other sources, including APUs, GSE and terminal boiler plant, f-NO_2 values of either 5% or 15% were assumed.

6.2 The calculator also requires an estimate of the regional ozone, NOx and NO_2 concentrations above the surface layer, which provides information on the amount of available oxidant: this is done by selecting a local authority, which allows the calculator to provide default values. The "Newry and Morne" district was selected to define these terms. It is also necessary to specific the "representative traffic mix"; this was assumed to be "all UK traffic". These assumptions have been based on guidance issued by NRA[7].

[27] Defra (2020) Available at http://www.defra.gov.uk/environment/quality/air/airquality

[28] NAEI available at http://naei.defra.gov.uk/datawarehouse

7 Spatial and Temporal Representation of Emissions

7.1 Emissions occur at different locations and over different time periods. The spatial representation of sources has been undertaken using a combination of line, point, area and volume sources. Aircraft taxiing and holding emissions were represented as line sources based on schematic taxi routes from the stands, to and from the runways. Emissions during take-off roll were distributed between the start-of-roll point on the runways and the estimated point of 'wheels-off'.

7.2 Aircraft movements, including taxiing, take-off, initial climb, climb-out, approach and landing roll-out are all contained within an "airfile" in ADMS-Airport. This file contains information on the geometry of individual aircraft, the engine exhaust parameters (exit velocity, temperature and diameter), the geometry of the LTO cycle (e.g. taxiway start and end points, take-off start and end points, approach start and end points etc.), the times in mode, and the aircraft emissions.

7.3 Each aircraft movement between spatial nodes is included as a separate line in the airfile. ADMS-Airport then treats each source as a series of fixed jet sources between each node point. Each line of the airfile is assigned an "NT number", which is the number of fixed jet sources along its length. For each part of the LTO cycle, there is a maximum jet source spacing, which is used to calculate NT. i.e. NT = (distance between aircraft start and end points) / (max jet-source spacing).

7.4 The emission rates contained within the airfile are annual average emission rates based on the number of movements of a particular aircraft or group of aircraft, assuming 100% usage of both Runway 10 (or 10R/10L) and Runway 28 (or 28R/28L). A time-varying emission file was then used to apportion the movements to the runways on an hour-by-hour basis, depending on wind direction. This time-varying file also accounts for the runway usage based on the mode of operation permitted by Condition 3a-c.

7.5 There are a small number of aircraft movements operating on the Cross Runway (16/34) in 2018 (~4%) and a smaller number (about 1%) assigned to the Cross Runway in future years with the North Runway in operation. In terms of annual mean pollutant concentrations, which are the principal focus of this assessment and the health impact assessment, these movements will have an indiscernible effect. For practical reasons, movements on the Cross Runway have been assigned to the main runway(s) on a proportional basis.

7.6 The mode of North Runway operation will be primarily assigned to Option 7b as defined in the 2007 planning permission, and is based on segregated mode. When winds are westerly, Runway 28L is preferred for arriving aircraft, with Runway 28R used for departing aircraft. During easterly operations Runway 10R is preferred for departing aircraft, with Runway 10L used for arriving aircraft. These modes have been applied to all future year operations.

7.7 Climb-out and approach trajectories have been calculated from information provided by the Airport. This includes the minimum angle of approach as well as indicative times between lift-off and throttle-back, approach and landing, and estimated aircraft speeds during these movements.

7.8 Emissions from airside ground activities, including the use of APUs and MGPUs, airside vehicle movements and aircraft main engine idling on stand (the time between engine start-up and start of taxi-out on departure) have been modelled as a series of volume sources, covering the main apron areas. Airside vehicle emissions and MGPU emissions are low-level and have therefore been modelled as volume sources with a depth of 2m and a source centre height of 1m. APU and aircraft main engine idling emissions have an initial release height, as the jet engines/APU units are elevated on the aircraft fuselage, and the emissions are hot, giving them a degree of buoyancy. To account for this, APU and aircraft idling emissions have been modelled as volume sources with a depth of 5m and a source centre height of 7.5m.

7.9 Emissions from the landside road network were calculated and assigned on a link-by-link basis. Road speeds were based on local speed limits, and were reduced close to junctions to take account of decelerating and accelerating vehicles, queuing and congestion.

8 Model Verification

8.1 The process of model verification compares modelled and measured values in order to evaluate the performance of the model at the local scale. Most nitrogen dioxide (NO_2) is produced in the atmosphere by reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emissions of nitrogen oxides (NOx = NO + NO_2). The model has been run to predict the annual mean NOx concentrations during 2018 at the Dublin Airport automatic monitor and at the network of diffusion tube monitoring sites. Concentrations have been modelled at 2.4 m, the height of the monitors. A summary of the 2018 measured nitrogen dioxide concentrations is shown in Table 6.

Table 6: Measured annual mean nitrogen dioxide concentrations 2018 (µg/m^3)

Site ID	Site Location	Annual Mean Nitrogen Dioxide Concentration 2018
Continuous Analyser	Dublin Airport	27.6
A1	Forrest Little Golf Club	20.6
A2	Kilreesk Lane, St Margaret's	16.7
A3	Ridgewood Estate West, Swords	17.4
A4	St Margaret's School and Parish House	18.6
A5	Fire Station, Huntstown, Dublin Airport	29.6
A6	Southern Boundary Fence, Dublin Airport	31.7
A7	Western Boundary Fence, Dublin Airport	30.0
A8	St. Nicholas of Myra School, Malahide Road	18.2
A9	Naomh Mearnog GAA Club	15.2
A10	Oscar Papa Site, Portmarnock	15.7

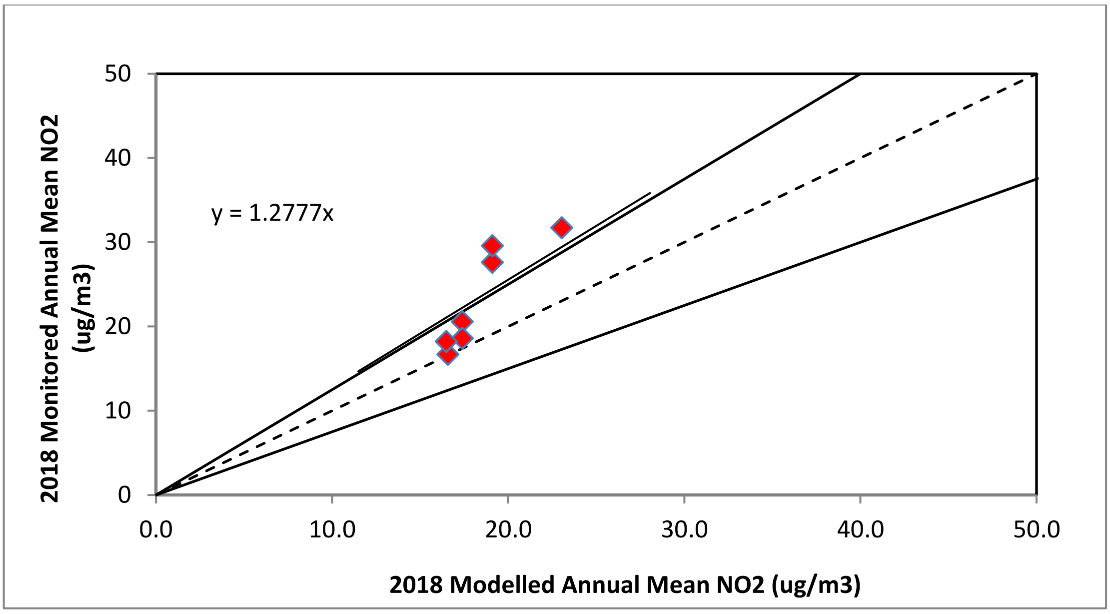
Note: Data for the continuous analyser derived from Dublin Airport Air Quality Monitoring Annual Report 2018 (HSSE Environment); data for the diffusion tube sites provided by daa.

8.2 Monitoring sites A9 and A10 are in background locations well away from major airport or road emissions sources and the annual mean concentrations measured at these sites in 2018 are slightly lower than the background concentrations measured at the Swords automatic monitoring station (as presented in Table 5). As such, these two sites have been discounted from the model verification. Monitoring sites A3 and A7 have also been discounted; site A3 is at a background location where the model over-predicts concentrations before any adjustment, and site A7 is very close to the R108, which is not included in the model domain.

8.3 An initial comparison of model outputs was carried out against measured NO_2 concentrations, based on combined "road-NOx" and "airport-NOx" concentrations (then converted to NO_2 in

Defra's "NOx:NO_2 calculator") together with estimated background NO_2 values. This shows an average under-prediction of 27.8% compared to measured concentrations, as shown in Figure 2.

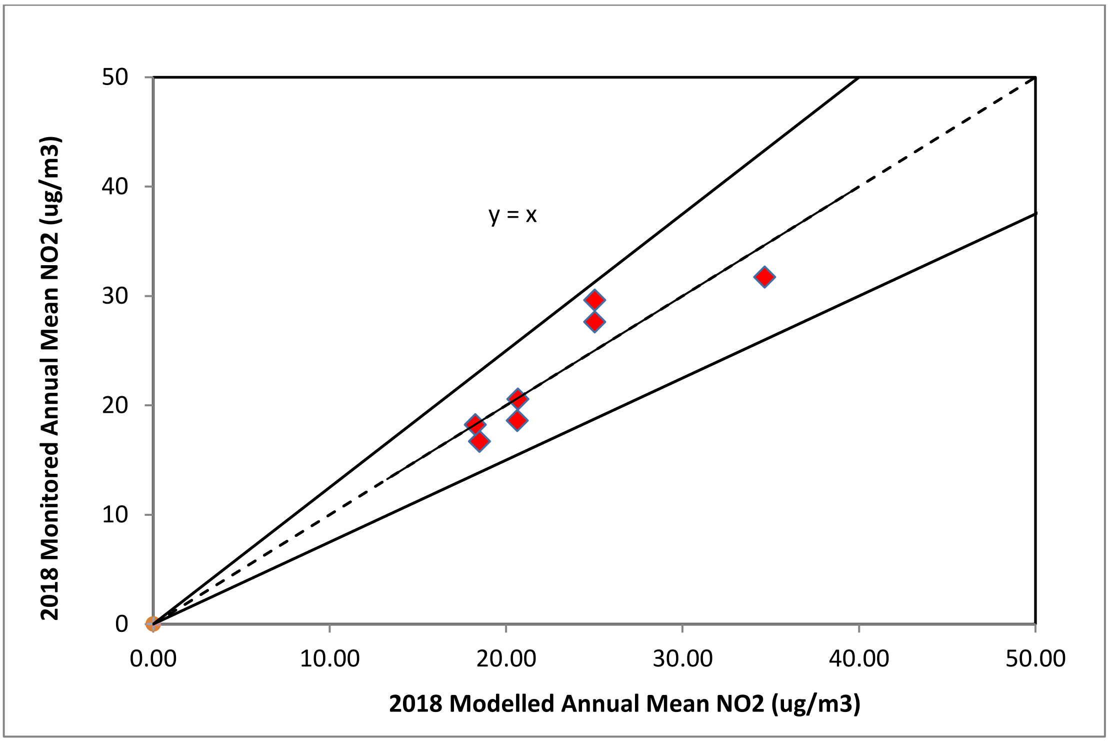
Figure 2: Modelled vs Measured NO_2



8.4 To adjust the model, the predicted "road-NOx" and predicted "airport-NOx" were combined and compared to the measured NOx at the diffusion tube sites (where measured NOx has been calculated using the NOx:NO_2 calculator). This generates a model NOx adjustment factor of 2.551. This adjustment factor has then been applied to uplift the predicted "road-NOx" and "airport-NOx" concentrations, and the total NO_2 recalculated using the NOx:NO_2 calculator. A comparison of predicted NO_2 with measured NO_2 indicates a secondary NO_2 adjustment of 1.06 is required.

8.5 LAQM.TG16 provides guidance on the evaluation of model performance. Based on the final adjusted modelled NO_2 concentrations the Root Mean Square Error (RMSE) is 2.5, the Fractional Bias is 0.0 and the correlation co-efficient is 0.9. LAQM.TG16 notes that where RMSE values are above 25% of the limit value (i.e. 10 µg/m^3) that model outputs and verification should be checked. It further notes that "ideally, an RMSE value with 10% of the limit value (4 µg/m^3) should be achieved. The ideal value for the Fractional Bias is 0.0. Based on these criteria, the model performance in this assessment is considered to be good. The final modelled vs measured NO_2 comparison is shown in Figure 3.

Figure 3: Adjusted Model Comparison



9 Description of Impacts

9.1 Guidance published by EPUK & IAQM Planning for Air Quality has been used to describe the magnitude of the impacts. This includes defining descriptors of the impacts at individual receptors which take account of the percentage change in concentrations relative to the limit value, rounded to the nearest whole number, and the absolute concentration relative to the limit value.

9.2 The impact descriptors express the magnitude of incremental change as a proportion of the relevant assessment level, and then examine this change in the context of the new, total concentration, and its relationship to the assessment criterion. Table 7 sets out the method for determining the impact descriptor for annual mean concentrations at individual receptors, and has been adapted from the table in the EPUK/IAQM guidance document. The Air Quality Assessment Level (AQAL) refers to the annual mean limit values. Impacts may be adverse or beneficial, depending on whether the change in concentration is positive or negative.

Table 7: Air Quality Impact Descriptors for Individual Receptors [a]

Long-Term Average Concentration At Receptor In Assessment Year [b]	Change in concentration relative to AQAL [c]				
	0%	1%	2-5%	6-10%	>10%
75% or less of AQAL	Negligible	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Negligible	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Negligible	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Negligible	Moderate	Substantial	Substantial	Substantial

[a] Values are rounded to the nearest whole number.

[b] This is the “Without Scheme” concentration where there is a decrease in pollutant concentration and the “With Scheme” concentration where there is an increase.

[c] AQAL = Air Quality Assessment Level, which may be an air quality objective, EU limit or target value, or an Environment Agency ‘Environmental Assessment Level (EAL)’.

10 Glossary

AADT	Annual Average Daily Traffic
ADMS-Airport	Atmospheric Dispersion Modelling System model for Airports
ADMS-Roads	Atmospheric Dispersion Modelling System model for Roads
AQAL	Air Quality Assessment Level
AQMA	Air Quality Management Area
CHP	Combined Heat and Power
Defra	Department for Environment, Food and Rural Affairs
EFT	Emission Factor Toolkit
EPUK	Environmental Protection UK
EU	European Union
HDV	Heavy Duty Vehicles (> 3.5 tonnes)
IAQM	Institute of Air Quality Management
ICCT	International Council on Clean Transportation
LAQM	Local Air Quality Management
LDV	Light Duty Vehicles (<3.5 tonnes)
$\mu g/m^3$	Microgrammes per cubic metre
NAEI	National Atmospheric Emissions Inventory
NO	Nitric oxide
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides (taken to be NO_2 + NO)
Objectives	A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides
PM_{10}	Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter
$PM_{2.5}$	Small airborne particles less than 2.5 micrometres in aerodynamic diameter

Standards A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal

11 Appendices

A1 Input Data Assumptions

Table A1.1: Aircraft Movements for Each Scenario

Aircraft Type	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
Airbus A306	300	300	-	-	-	-
Airbus A318	601	601	651	651	-	-
Airbus A319	1,803	1,802	651	651	651	651
Airbus A320	36,954	40,254	47,502	50,105	24,727	24,727
Airbus A320neo	2,403	2,403	15,617	15,617	41,645	41,645
Airbus A321	5,408	6,609	651	651	651	651
Airbus A321neo	2,403	2,403	7,158	8,459	10,411	8,459
Airbus A330	9,614	9,613	12,038	12,038	6,832	6,832
Airbus A330neo	-	-	2,603	2,603	6,507	6,507
Airbus A350	-	-	651	651	651	651
ATR 42	2,403	2,403	2,603	2,603	2,603	2,603
ATR 72	17,425	17,423	18,871	18,871	18,871	18,871
Boeing 737-400	1,803	1,802	651	651	651	651
Boeing 737-700	-	-	651	651	-	-
Boeing 737-800	60,688	66,089	72,229	78,736	11,713	11,062
Boeing 737 MAX	3,605	3,605	15,617	14,316	79,387	82,640
Boeing 767	1,803	1,802	1,952	1,952	1,952	1,952
Boeing 777	1,202	1,202	651	651	651	651
Boeing 777X	-	-	1,301	1,301	1,301	1,301
Boeing 787	4,807	4,806	7,158	7,158	8,459	8,459
Bombardier CS300	1,202	1,202	1,301	1,301	1,952	1,301
Bombardier Dash 8	1,803	1,802	3,254	3,254	3,254	3,254
Embraer ERJ-145	601	601	651	651	651	651
Embraer E170	601	601	1,952	1,952	1,952	1,952
Embraer E190/E195	7,811	7,811	9,761	9,761	651	651
Embraer E190-E2	-	-	-	-	9,110	9,110
Cessna Light Aircraft	601	601	651	651	651	651
Total	**165,840**	**175,737**	**226,772**	**235,882**	**235,882**	**235,882**

Table A1.2: 2018 Baseline Aircraft Group Assignments

Group Name	Description	Aircraft in Group[1]	Engine Assignment	No. Engines	Engine Type	Engine Mounting	Wake Category
MCAT01	Boeing 737	**Boeing 737-800,** 737-400, 737-700, 737-MAX	CFM56-7B27	2	Turbofan	Wing	M
MCAT02	Airbus A319-A321	Airbus A319, **A320**, A321	CFM56-5B4/P	2	Turbofan	Wing	M
MCAT03	Large Turboprops	**ATR-72**, Airbus 72, Bombardier Dash-8	PW127	2	Turboprop	Wing	M
MCAT04	Regional Jets	**Embraer E190,** E195, E190-E2, Bombardier CS300	CF34-10E7	2	Turbofan	Wing	M
MCAT05	Airbus A330	**Airbus A330-200**	GE CF6-80E1A4	2	Turbofan	Wing	H
MCAT06	Boeing 777	**Boeing 777-300ER**	GE90-115B	2	Turbofan	Wing	H
MCAT07	Boeing 787	**Boeing 787**	Trent 1000-J2	2	Turbofan	Wing	H
MCAT08	Narrow Body Jets	**Boeing 757**, Boeing 767, Airbus A306	RB211-535E4B	2	Turbofan	Wing	M
MCAT09	Other	**Cessna Citation V**, Learjet 45, business jets, general aviation flights, military and helicopters	AE3007C1	2	Turbofan	Wing	M

[1] The “lead” aircraft assigned in each group is shown in bold

Table A1.3: 2022, 2025 and 2035 Permitted (Do-Nothing) and Relevant Action (Do-Something) Operations Aircraft Group Assignments

Group Name	Description	Aircraft in Group[1]	Engine Assignment	No. Engines	Engine Type	Engine Mounting	Wake Category
MCAT01	Current Generation Boeing 737	**Boeing 737-800**	CFM56-7B27	2	Turbofan	Wing	M
MCAT02	Current Generation Airbus A318-A321	Airbus A318, A319, **A320**, A321	CFM56-5B4/P	2	Turbofan	Wing	M
MCAT03	Large Turboprops	**ATR-72**, ATR-42, Airbus 72, Bombardier Dash-8	PW127	2	Turboprop	Wing	M
MCAT04	Regional Jets	**Embraer E190,** E195, E195-2, E170, ERJ-145, Bombardier CS300	CF34-10E7	2	Turbofan	Wing	M
MCAT05	Airbus A320 neo	**Airbus A320 neo**	LEAP-1A26/26E1	2	Turbofan	Wing	M
MCAT06	Airbus A321 neo	**Airbus A321 neo**	LEAP-1A35A /33/33B2 /32/30	2	Turbofan	Wing	M
MCAT07	Large Wide Body Jets	**Boeing 787**, Boeing 777, Airbus A330 neo Airbus A350	Trent 1000-J2	2	Turbofan	Wing	H
MCAT08	Boeing 737 MAX	**Boeing 737 MAX**	LEAP-1B27	2	Turbofan	Wing	M
MCAT09	Small Wide Body Jets	**Airbus A330-200**, Boeing 767, Airbus A306	GE CF6-80E1A4	2	Turbofan	Wing	H
MCAT10	Other	**Cessna Citation V**, Cesna Light Aircraft, Learjet 45, business jets, general aviation flights, and helicopters	AE3007C1	2	Turbofan	Wing	M

1 The "lead" aircraft assigned in each group is shown in bold.

Table A1.4: Times-in-Mode

Mode	Time (sec)	Thrust Setting
Departures		
Taxi to Runway	See Table A1.	7%
Hold at Runway End	582	7%
Start of roll to lift off	38	100%
Initial climb to throttle-back	44	100%
Climbout to 915m	73	85%
Arrivals		
Approach (915 to touchdown)	246	30%
Landing roll	30	7%
Taxi from Runway	See Table A1.	7%

Table A1.5: Taxi-Times

Runway	Stand Group	Taxi Time (sec)
Departures (Taxi out to runway)		
28L	100	263
	200	210
	300	143
	400	138
10R	100	425
	200	291
	300	490
	400	656
28R	100	324
	200	359
	300	430
	400	429
10L	100	361
	200	396
	300	468
	400	467
Arrivals (Taxi in to stand)		
28L	100	359
	200	297
	300	381
	400	462
10R	100	259
	200	206

	300	259
	400	283
28R	100	326
	200	360
	300	432
	400	431
10L	100	282
	200	317
	300	389
	400	388

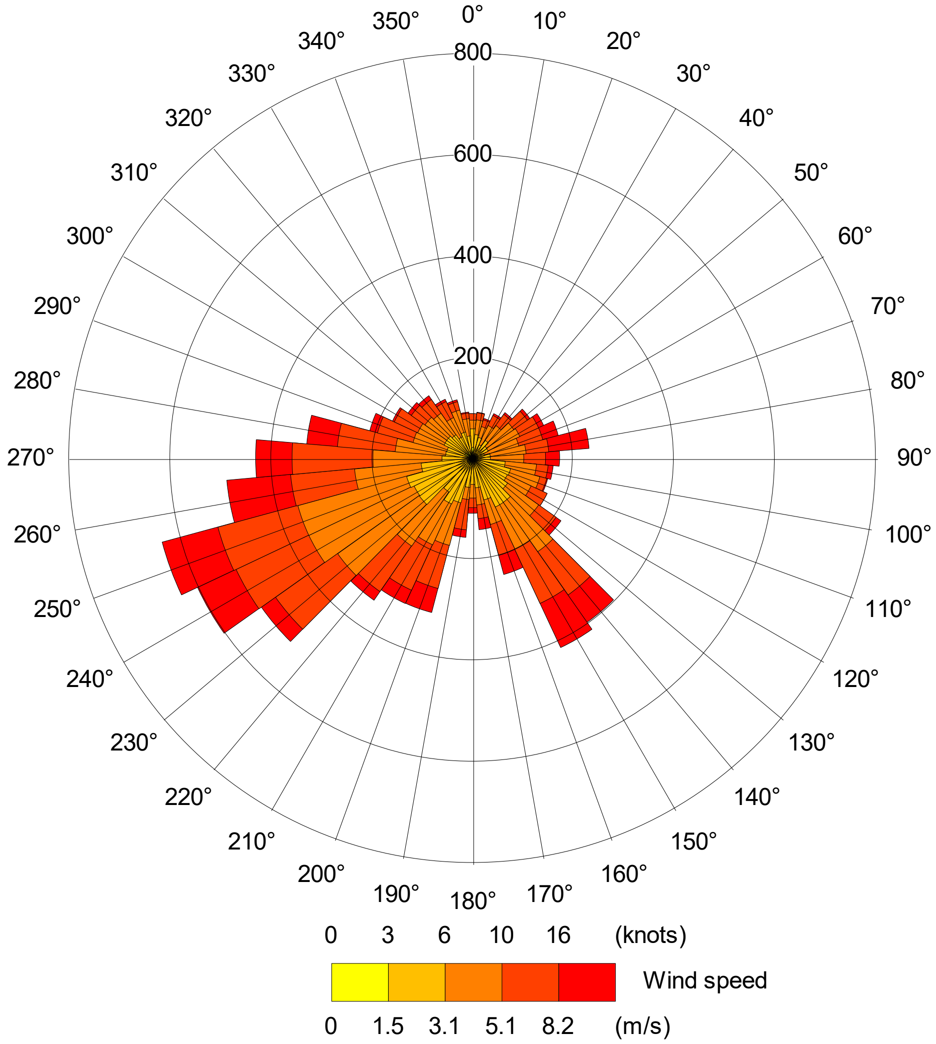
Table A1.6: Traffic Data

Road Link	Permitted		Proposed	
	AADT	%HDV	AADT	%HDV
2022				
Naul Road	14,102	3.9	14,151	3.9
R132 Swords Road (North of Airport)	23,517	6.3	23,660	6.2
M1 Link Road	33,171	6.0	34,424	5.7
M1 Motorway (South of Airport Interchange)	115,181	4.6	116,587	4.5
R132 Swords Road (South of Airport)	20,087	9.5	20,182	9.4
Old Airport Road	15,368	9.3	15,846	9.0
M50 Motorway	108,327	6.0	109,381	5.9
2025				
Naul Road	18,435	4.3	18,477	4.3
R132 Swords Road (North of Airport)	30,771	6.6	30,894	6.6
M1 Link Road	67,023	6.3	68,472	6.2
M1 Motorway (South of Airport Interchange)	152,079	5.4	153,282	5.3
R132 Swords Road (South of Airport)	26,271	9.6	26,352	9.5
Old Airport Road	20,281	9.8	20,690	9.6
M50 Motorway	138,516	6.8	139,418	6.7
2035				
Naul Road	19,040	4.8	19,045	4.8
R132 Swords Road (North of Airport)	33,764	7.0	33,777	7.0
M1 Link Road	68,385	6.6	68,542	6.6
M1 Motorway (South of Airport Interchange)	157,615	6.1	157,745	6.1
R132 Swords Road (South of Airport)	29,022	9.6	29,031	9.6
Old Airport Road	22,029	10.1	22,073	10.1
M50 Motorway	140,226	7.6	140,323	7.6

Source: Data provided by Aecom

A2 Wind Rose

Figure A2.1 Wind Rose for Dublin Airport 2018



A3 Results

2018 Baseline Results

Table A3.1: Modelled Annual Mean Baseline Concentrations of NO_2, PM_{10} and $PM_{2.5}$ (µg/m^3)

Receptor [a]	NO_2	PM_{10}	$PM_{2.5}$
1	25.8	11.3	7.0
2	27.2	11.4	7.1
3	23.6	11.3	7.0
4	31.2	11.6	7.2
5	39.1	11.9	7.4
6	26.7	11.5	7.2
7	28.8	11.6	7.2
8	26.7	11.5	7.2
9	21.3	11.2	7.0
10	17.7	11.0	6.8
11	19.8	11.1	6.9
12	18.8	11.1	6.8
13	18.8	11.1	6.8
14	18.0	11.0	6.8
15	21.3	11.2	6.9
16	23.7	11.3	7.0
17	23.5	11.3	7.0
18	19.5	11.1	6.9
19	20.1	11.1	6.9
20	19.2	11.1	6.9
21	19.1	11.1	6.9
22	18.0	11.0	6.8
23	27.0	11.5	7.1
24	21.7	11.2	6.9
25	19.7	11.1	6.9
26	20.2	11.1	6.9
27	20.1	11.1	6.9
28	20.9	11.2	6.9
29	20.7	11.2	6.9
30	21.0	11.2	6.9
31	19.3	11.1	6.9

Receptor [a]	NO_2	PM_{10}	$PM_{2.5}$
32	21.7	11.2	7.0
33	26.5	11.5	7.2
34	23.7	11.2	7.0
35	19.9	11.1	6.9
36	24.5	11.4	7.1
37	19.2	11.1	6.9
38	18.5	11.1	6.8
39	20.7	11.1	6.9
40	24.5	11.4	7.2
41	19.1	11.1	6.9
42	19.9	11.1	6.9
43	18.2	11.1	6.8
44	18.5	11.1	6.8
45	19.6	11.1	6.9
46	18.3	11.0	6.8
47	18.3	11.1	6.8
48	18.5	11.1	6.8
49	20.7	11.1	6.9
50	18.3	11.1	6.8
51	32.4	11.6	7.2
52	20.8	11.1	6.9
Objective	**40**	**40**	**20 [b]**

[a] Receptors modelled at a height of 1.5 m.

[b] Objective as of 2020.

Nitrogen Dioxide Results

Table A3.2: Predicted Impacts on Annual Mean NO_2 Concentrations in 2022 (µg/m^3)

Receptor	Permitted	Proposed	% Change	Impact Descriptor
1	20.2	20.3	0	Negligible
2	21.8	22.1	1	Negligible
3	18.3	18.4	0	Negligible
4	22.4	22.4	0	Negligible
5	27.2	27.3	0	Negligible
6	20.1	20.1	0	Negligible
7	21.3	21.3	0	Negligible

Receptor	Permitted	Proposed	% Change	Impact Descriptor
8	24.6	25.3	2	Negligible
9	20.3	20.7	1	Negligible
10	15.1	15.1	0	Negligible
11	16.9	17.1	0	Negligible
12	16.1	16.2	0	Negligible
13	16.0	16.2	0	Negligible
14	15.3	15.4	0	Negligible
15	20.2	20.8	2	Negligible
16	21.2	21.7	1	Negligible
17	20.2	20.6	1	Negligible
18	16.2	16.3	0	Negligible
19	17.0	17.3	1	Negligible
20	16.3	16.4	0	Negligible
21	16.1	16.1	0	Negligible
22	15.3	15.3	0	Negligible
23	20.0	20.0	0	Negligible
24	17.3	17.3	0	Negligible
25	16.2	16.2	0	Negligible
26	17.2	17.4	1	Negligible
27	16.8	17.0	0	Negligible
28	17.7	17.9	1	Negligible
29	17.0	17.2	0	Negligible
30	17.5	17.8	1	Negligible
31	16.7	16.8	0	Negligible
32	23.8	24.8	3	Negligible
33	18.5	18.3	-1	Negligible
34	19.6	19.9	1	Negligible
35	16.8	17.0	1	Negligible
36	19.1	19.4	1	Negligible
37	15.8	15.8	0	Negligible
38	15.7	15.8	0	Negligible
39	17.6	17.9	1	Negligible
40	18.3	18.3	0	Negligible
41	17.0	17.3	1	Negligible
42	18.8	19.3	1	Negligible
43	15.6	15.7	0	Negligible

Receptor	Permitted	Proposed	% Change	Impact Descriptor
44	16.1	16.3	0	Negligible
45	16.8	17.0	0	Negligible
46	15.4	15.5	0	Negligible
47	15.3	15.4	0	Negligible
48	15.4	15.4	0	Negligible
49	16.5	16.5	0	Negligible
50	15.6	15.7	0	Negligible
51	23.2	23.3	0	Negligible
52	18.3	18.6	1	Negligible
Objective	**40**		**-**	**-**

[a] Receptors modelled at a height of 1.5 m.

[b] % changes are relative to the objective and have been rounded to the nearest whole number.

Table A3.3: Predicted Impacts on Annual Mean NO_2 Concentrations in 2025 (µg/m³)

Receptor	Permitted	Proposed	% Change	Impact Descriptor
1	19.8	19.9	0	Negligible
2	21.3	21.5	0	Negligible
3	17.3	17.4	0	Negligible
4	21.2	21.2	0	Negligible
5	25.8	25.9	0	Negligible
6	19.6	19.5	0	Negligible
7	20.8	20.9	0	Negligible
8	25.8	26.2	1	Negligible
9	20.5	20.9	1	Negligible
10	13.8	13.8	0	Negligible
11	16.5	16.8	1	Negligible
12	15.2	15.4	0	Negligible
13	15.2	15.3	0	Negligible
14	14.2	14.2	0	Negligible
15	20.7	21.0	1	Negligible
16	21.9	22.2	1	Negligible
17	20.5	20.8	1	Negligible
18	15.2	15.3	0	Negligible
19	16.8	16.8	0	Negligible
20	15.5	15.6	0	Negligible
21	15.1	15.1	0	Negligible

Receptor	Permitted	Proposed	% Change	Impact Descriptor
22	14.1	14.1	0	Negligible
23	19.5	19.6	0	Negligible
24	16.2	16.3	0	Negligible
25	15.1	15.1	0	Negligible
26	17.2	17.5	1	Negligible
27	16.5	16.7	1	Negligible
28	17.7	17.9	0	Negligible
29	16.7	16.8	0	Negligible
30	17.6	17.7	0	Negligible
31	16.1	16.4	1	Negligible
32	25.5	26.1	2	Negligible
33	18.1	18.1	0	Negligible
34	20.2	19.8	-1	Negligible
35	16.4	16.4	0	Negligible
36	19.7	19.6	0	Negligible
37	14.5	14.6	0	Negligible
38	14.7	14.7	0	Negligible
39	17.5	17.6	0	Negligible
40	18.3	18.3	0	Negligible
41	16.5	16.7	0	Negligible
42	19.0	19.3	1	Negligible
43	14.6	14.7	0	Negligible
44	15.3	15.4	0	Negligible
45	15.9	16.1	0	Negligible
46	14.2	14.3	0	Negligible
47	14.1	14.1	0	Negligible
48	14.1	14.1	0	Negligible
49	15.3	15.3	0	Negligible
50	14.5	14.6	0	Negligible
51	21.9	21.9	0	Negligible
52	17.9	18.1	1	Negligible
Objective	**40**		-	-

[a] Receptors modelled at a height of 1.5 m.

[b] % changes are relative to the objective and have been rounded to the nearest whole number.

Table A3.4: Predicted Impacts on Annual Mean NO_2 Concentrations in 2035 (μg/m³)

Receptor	Permitted	Proposed	% Change	Impact Descriptor
1	17.8	17.8	0	Negligible
2	19.0	19.1	0	Negligible
3	15.6	15.6	0	Negligible
4	18.3	18.2	0	Negligible
5	21.3	21.3	0	Negligible
6	17.9	17.8	0	Negligible
7	18.9	18.9	0	Negligible
8	24.6	24.7	0	Negligible
9	19.9	20.1	0	Negligible
10	12.9	12.9	0	Negligible
11	15.9	16.0	0	Negligible
12	14.5	14.5	0	Negligible
13	14.4	14.5	0	Negligible
14	13.4	13.4	0	Negligible
15	20.0	20.2	0	Negligible
16	21.1	21.1	0	Negligible
17	19.6	19.6	0	Negligible
18	14.2	14.2	0	Negligible
19	16.0	16.1	0	Negligible
20	14.7	14.7	0	Negligible
21	14.2	14.2	0	Negligible
22	13.2	13.2	0	Negligible
23	17.9	17.9	0	Negligible
24	14.8	14.8	0	Negligible
25	14.0	14.0	0	Negligible
26	16.7	16.8	0	Negligible
27	15.9	15.9	0	Negligible
28	17.1	17.2	0	Negligible
29	16.0	16.0	0	Negligible
30	17.0	17.0	0	Negligible
31	15.6	15.6	0	Negligible
32	25.5	25.8	1	Negligible
33	16.9	16.7	0	Negligible
34	19.3	19.3	0	Negligible
35	15.6	15.6	0	Negligible

Receptor	Permitted	Proposed	% Change	Impact Descriptor
36	19.0	19.0	0	Negligible
37	13.5	13.5	0	Negligible
38	13.8	13.8	0	Negligible
39	16.7	16.8	0	Negligible
40	17.5	17.4	0	Negligible
41	15.9	15.9	0	Negligible
42	18.5	18.7	0	Negligible
43	13.9	13.9	0	Negligible
44	14.5	14.5	0	Negligible
45	14.9	15.0	0	Negligible
46	13.3	13.3	0	Negligible
47	13.1	13.1	0	Negligible
48	13.1	13.1	0	Negligible
49	14.1	14.1	0	Negligible
50	13.7	13.7	0	Negligible
51	18.6	18.6	0	Negligible
52	16.9	16.9	0	Negligible
Objective	**40**		**-**	**-**

[a] Receptors modelled at a height of 1.5 m.

[b] % changes are relative to the objective and have been rounded to the nearest whole number.

PM_{10} Results

Table A3.5: Predicted Impacts on Annual Mean PM_{10} Concentrations in 2022 (µg/m^3)

Receptor	Permitted	Proposed	% Change	Impact Descriptor
1	10.8	10.8	0	Negligible
2	10.8	10.8	0	Negligible
3	10.7	10.7	0	Negligible
4	10.9	10.9	0	Negligible
5	11.1	11.1	0	Negligible
6	10.9	10.9	0	Negligible
7	11.0	11.0	0	Negligible
8	11.0	11.1	0	Negligible
9	10.8	10.8	0	Negligible
10	10.5	10.5	0	Negligible
11	10.6	10.6	0	Negligible

Receptor	Permitted	Proposed	% Change	Impact Descriptor
12	10.6	10.6	0	Negligible
13	10.6	10.6	0	Negligible
14	10.6	10.6	0	Negligible
15	10.7	10.8	0	Negligible
16	10.8	10.8	0	Negligible
17	10.8	10.8	0	Negligible
18	10.6	10.6	0	Negligible
19	10.6	10.6	0	Negligible
20	10.6	10.6	0	Negligible
21	10.6	10.6	0	Negligible
22	10.6	10.6	0	Negligible
23	10.9	10.9	0	Negligible
24	10.6	10.7	0	Negligible
25	10.6	10.6	0	Negligible
26	10.6	10.6	0	Negligible
27	10.6	10.6	0	Negligible
28	10.6	10.6	0	Negligible
29	10.6	10.6	0	Negligible
30	10.6	10.6	0	Negligible
31	10.7	10.7	0	Negligible
32	10.9	10.9	0	Negligible
33	10.8	10.8	0	Negligible
34	10.7	10.7	0	Negligible
35	10.6	10.6	0	Negligible
36	10.7	10.7	0	Negligible
37	10.6	10.6	0	Negligible
38	10.6	10.6	0	Negligible
39	10.6	10.6	0	Negligible
40	10.8	10.8	0	Negligible
41	10.6	10.6	0	Negligible
42	10.7	10.7	0	Negligible
43	10.6	10.6	0	Negligible
44	10.6	10.6	0	Negligible
45	10.6	10.6	0	Negligible
46	10.6	10.6	0	Negligible
47	10.6	10.6	0	Negligible

Receptor	Permitted	Proposed	% Change	Impact Descriptor
48	10.6	10.6	0	Negligible
49	10.6	10.6	0	Negligible
50	10.6	10.6	0	Negligible
51	10.9	10.9	0	Negligible
52	10.7	10.7	0	Negligible
Objective	**40**		-	-

[a] Receptors modelled at a height of 1.5 m.

[b] % changes are relative to the objective and have been rounded to the nearest whole number.

Table A3.6: Predicted Impacts on Annual Mean PM_{10} Concentrations in 2025 (µg/m^3)

Receptor	Permitted	Proposed	% Change	Impact Descriptor
1	10.6	10.6	0	Negligible
2	10.6	10.6	0	Negligible
3	10.4	10.4	0	Negligible
4	10.7	10.7	0	Negligible
5	10.9	10.9	0	Negligible
6	10.7	10.7	0	Negligible
7	10.8	10.8	0	Negligible
8	10.9	10.9	0	Negligible
9	10.6	10.6	0	Negligible
10	10.2	10.2	0	Negligible
11	10.3	10.3	0	Negligible
12	10.3	10.3	0	Negligible
13	10.3	10.3	0	Negligible
14	10.2	10.2	0	Negligible
15	10.5	10.5	0	Negligible
16	10.6	10.6	0	Negligible
17	10.5	10.5	0	Negligible
18	10.3	10.3	0	Negligible
19	10.3	10.3	0	Negligible
20	10.3	10.3	0	Negligible
21	10.3	10.3	0	Negligible
22	10.2	10.2	0	Negligible
23	10.6	10.6	0	Negligible
24	10.4	10.4	0	Negligible
25	10.3	10.3	0	Negligible

Receptor	Permitted	Proposed	% Change	Impact Descriptor
26	10.3	10.3	0	Negligible
27	10.3	10.3	0	Negligible
28	10.3	10.4	0	Negligible
29	10.3	10.4	0	Negligible
30	10.4	10.4	0	Negligible
31	10.4	10.4	0	Negligible
32	10.7	10.7	0	Negligible
33	10.6	10.6	0	Negligible
34	10.4	10.4	0	Negligible
35	10.3	10.3	0	Negligible
36	10.5	10.5	0	Negligible
37	10.3	10.3	0	Negligible
38	10.3	10.3	0	Negligible
39	10.3	10.3	0	Negligible
40	10.5	10.5	0	Negligible
41	10.3	10.3	0	Negligible
42	10.4	10.4	0	Negligible
43	10.3	10.3	0	Negligible
44	10.3	10.3	0	Negligible
45	10.3	10.3	0	Negligible
46	10.3	10.3	0	Negligible
47	10.3	10.3	0	Negligible
48	10.3	10.3	0	Negligible
49	10.3	10.3	0	Negligible
50	10.3	10.3	0	Negligible
51	10.7	10.7	0	Negligible
52	10.4	10.4	0	Negligible
Objective	40		-	-

[a] Receptors modelled at a height of 1.5 m.

[b] % changes are relative to the objective and have been rounded to the nearest whole number.

Table A3.7: Predicted Impacts on Annual Mean PM_{10} Concentrations in 2035 (µg/m^3)

Receptor	Permitted	Proposed	% Change	Impact Descriptor
1	10.5	10.5	0	Negligible
2	10.5	10.5	0	Negligible
3	10.3	10.3	0	Negligible

Receptor	Permitted	Proposed	% Change	Impact Descriptor
4	10.6	10.6	0	Negligible
5	10.9	10.9	0	Negligible
6	10.6	10.6	0	Negligible
7	10.7	10.7	0	Negligible
8	10.8	10.8	0	Negligible
9	10.5	10.5	0	Negligible
10	10.1	10.1	0	Negligible
11	10.2	10.2	0	Negligible
12	10.2	10.2	0	Negligible
13	10.2	10.2	0	Negligible
14	10.2	10.2	0	Negligible
15	10.3	10.3	0	Negligible
16	10.5	10.5	0	Negligible
17	10.4	10.4	0	Negligible
18	10.2	10.2	0	Negligible
19	10.2	10.2	0	Negligible
20	10.2	10.2	0	Negligible
21	10.2	10.2	0	Negligible
22	10.1	10.1	0	Negligible
23	10.6	10.6	0	Negligible
24	10.3	10.3	0	Negligible
25	10.2	10.2	0	Negligible
26	10.2	10.2	0	Negligible
27	10.2	10.2	0	Negligible
28	10.2	10.2	0	Negligible
29	10.2	10.2	0	Negligible
30	10.2	10.2	0	Negligible
31	10.3	10.3	0	Negligible
32	10.4	10.4	0	Negligible
33	10.5	10.5	0	Negligible
34	10.2	10.2	0	Negligible
35	10.2	10.2	0	Negligible
36	10.3	10.3	0	Negligible
37	10.2	10.2	0	Negligible
38	10.2	10.2	0	Negligible
39	10.2	10.2	0	Negligible

Receptor	Permitted	Proposed	% Change	Impact Descriptor
40	10.4	10.4	0	Negligible
41	10.2	10.2	0	Negligible
42	10.3	10.3	0	Negligible
43	10.2	10.2	0	Negligible
44	10.2	10.2	0	Negligible
45	10.2	10.2	0	Negligible
46	10.2	10.2	0	Negligible
47	10.2	10.2	0	Negligible
48	10.2	10.2	0	Negligible
49	10.2	10.2	0	Negligible
50	10.2	10.2	0	Negligible
51	10.6	10.6	0	Negligible
52	10.3	10.3	0	Negligible
Objective	40		-	-

[a] Receptors modelled at a height of 1.5 m.

[b] % changes are relative to the objective and have been rounded to the nearest whole number.

$PM_{2.5}$ Results

Table A3.8: Predicted Impacts on Annual Mean $PM_{2.5}$ Concentrations in 2022 (µg/m^3)

Receptor	Permitted	Proposed	% Change	Impact Descriptor
1	6.6	6.6	0	Negligible
2	6.6	6.6	0	Negligible
3	6.5	6.5	0	Negligible
4	6.6	6.6	0	Negligible
5	6.8	6.8	0	Negligible
6	6.7	6.7	0	Negligible
7	6.7	6.7	0	Negligible
8	6.8	6.8	0	Negligible
9	6.6	6.7	0	Negligible
10	6.4	6.4	0	Negligible
11	6.5	6.5	0	Negligible
12	6.4	6.4	0	Negligible
13	6.4	6.4	0	Negligible
14	6.4	6.4	0	Negligible
15	6.6	6.6	0	Negligible

Receptor	Permitted	Proposed	% Change	Impact Descriptor
16	6.6	6.7	0	Negligible
17	6.6	6.6	0	Negligible
18	6.4	6.4	0	Negligible
19	6.5	6.5	0	Negligible
20	6.4	6.4	0	Negligible
21	6.4	6.4	0	Negligible
22	6.4	6.4	0	Negligible
23	6.6	6.6	0	Negligible
24	6.5	6.5	0	Negligible
25	6.4	6.4	0	Negligible
26	6.5	6.5	0	Negligible
27	6.5	6.5	0	Negligible
28	6.5	6.5	0	Negligible
29	6.5	6.5	0	Negligible
30	6.5	6.5	0	Negligible
31	6.5	6.5	0	Negligible
32	6.7	6.8	0	Negligible
33	6.6	6.6	0	Negligible
34	6.5	6.5	0	Negligible
35	6.5	6.5	0	Negligible
36	6.6	6.6	0	Negligible
37	6.4	6.4	0	Negligible
38	6.4	6.4	0	Negligible
39	6.5	6.5	0	Negligible
40	6.6	6.6	0	Negligible
41	6.5	6.5	0	Negligible
42	6.5	6.5	0	Negligible
43	6.4	6.4	0	Negligible
44	6.4	6.4	0	Negligible
45	6.5	6.5	0	Negligible
46	6.4	6.4	0	Negligible
47	6.4	6.4	0	Negligible
48	6.4	6.4	0	Negligible
49	6.5	6.5	0	Negligible
50	6.4	6.4	0	Negligible
51	6.6	6.6	0	Negligible

Receptor	Permitted	Proposed	% Change	Impact Descriptor
52	6.5	6.5	0	Negligible
Objective	20		-	-

a Receptors modelled at a height of 1.5 m.

b % changes are relative to the objective and have been rounded to the nearest whole number.

Table A3.9: Predicted Impacts on Annual Mean $PM_{2.5}$ Concentrations in 2025 (µg/m^3)

Receptor	Permitted	Proposed	% Change	Impact Descriptor
1	6.4	6.4	0	Negligible
2	6.4	6.4	0	Negligible
3	6.3	6.3	0	Negligible
4	6.4	6.4	0	Negligible
5	6.6	6.6	0	Negligible
6	6.5	6.5	0	Negligible
7	6.5	6.5	0	Negligible
8	6.7	6.7	0	Negligible
9	6.4	6.5	0	Negligible
10	6.1	6.1	0	Negligible
11	6.2	6.2	0	Negligible
12	6.2	6.2	0	Negligible
13	6.2	6.2	0	Negligible
14	6.2	6.2	0	Negligible
15	6.4	6.4	0	Negligible
16	6.5	6.5	0	Negligible
17	6.4	6.4	0	Negligible
18	6.2	6.2	0	Negligible
19	6.2	6.2	0	Negligible
20	6.2	6.2	0	Negligible
21	6.2	6.2	0	Negligible
22	6.1	6.1	0	Negligible
23	6.4	6.4	0	Negligible
24	6.2	6.2	0	Negligible
25	6.2	6.2	0	Negligible
26	6.2	6.3	0	Negligible
27	6.2	6.2	0	Negligible
28	6.3	6.3	0	Negligible
29	6.2	6.3	0	Negligible

Receptor	Permitted	Proposed	% Change	Impact Descriptor
30	6.3	6.3	0	Negligible
31	6.3	6.3	0	Negligible
32	6.5	6.6	0	Negligible
33	6.4	6.4	0	Negligible
34	6.3	6.3	0	Negligible
35	6.2	6.2	0	Negligible
36	6.4	6.4	0	Negligible
37	6.2	6.2	0	Negligible
38	6.2	6.2	0	Negligible
39	6.2	6.2	0	Negligible
40	6.4	6.4	0	Negligible
41	6.2	6.2	0	Negligible
42	6.3	6.3	0	Negligible
43	6.2	6.2	0	Negligible
44	6.2	6.2	0	Negligible
45	6.2	6.2	0	Negligible
46	6.2	6.2	0	Negligible
47	6.2	6.2	0	Negligible
48	6.2	6.2	0	Negligible
49	6.2	6.2	0	Negligible
50	6.2	6.2	0	Negligible
51	6.4	6.4	0	Negligible
52	6.3	6.3	0	Negligible
Objective	20		-	-

[a] Receptors modelled at a height of 1.5 m.

[b] % changes are relative to the objective and have been rounded to the nearest whole number.

Table A3.10: Predicted Impacts on Annual Mean $PM_{2.5}$ Concentrations in 2035 ($\mu g/m^3$) [a]

Receptor	Permitted	Proposed	% Change	Impact Descriptor
1	6.3	6.3	0	Negligible
2	6.3	6.3	0	Negligible
3	6.2	6.2	0	Negligible
4	6.4	6.4	0	Negligible
5	6.5	6.5	0	Negligible
6	6.4	6.4	0	Negligible
7	6.4	6.4	0	Negligible

Receptor	Permitted	Proposed	% Change	Impact Descriptor
8	6.5	6.5	0	Negligible
9	6.3	6.3	0	Negligible
10	6.1	6.1	0	Negligible
11	6.1	6.1	0	Negligible
12	6.1	6.1	0	Negligible
13	6.1	6.1	0	Negligible
14	6.1	6.1	0	Negligible
15	6.2	6.2	0	Negligible
16	6.3	6.3	0	Negligible
17	6.3	6.3	0	Negligible
18	6.1	6.1	0	Negligible
19	6.1	6.1	0	Negligible
20	6.1	6.1	0	Negligible
21	6.1	6.1	0	Negligible
22	6.1	6.1	0	Negligible
23	6.3	6.3	0	Negligible
24	6.2	6.2	0	Negligible
25	6.1	6.1	0	Negligible
26	6.1	6.1	0	Negligible
27	6.1	6.1	0	Negligible
28	6.1	6.1	0	Negligible
29	6.1	6.1	0	Negligible
30	6.1	6.1	0	Negligible
31	6.2	6.2	0	Negligible
32	6.3	6.3	0	Negligible
33	6.3	6.3	0	Negligible
34	6.1	6.1	0	Negligible
35	6.1	6.1	0	Negligible
36	6.2	6.2	0	Negligible
37	6.1	6.1	0	Negligible
38	6.1	6.1	0	Negligible
39	6.1	6.1	0	Negligible
40	6.3	6.3	0	Negligible
41	6.1	6.1	0	Negligible
42	6.2	6.2	0	Negligible
43	6.1	6.1	0	Negligible

Receptor	Permitted	Proposed	% Change	Impact Descriptor
44	6.1	6.1	0	Negligible
45	6.1	6.1	0	Negligible
46	6.1	6.1	0	Negligible
47	6.1	6.1	0	Negligible
48	6.1	6.1	0	Negligible
49	6.1	6.1	0	Negligible
50	6.1	6.1	0	Negligible
51	6.4	6.4	0	Negligible
52	6.2	6.2	0	Negligible
Objective	20		-	-

[a] Receptors modelled at a height of 1.5 m.

[b] % changes are relative to the objective and have been rounded to the nearest whole number.

Odour Results

Table A3.11: Predicted Odour Concentrations (OU_E/m^3) (98th Percentile) [a]

Receptor	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
1	0.1	0.1	0.1	0.1	0.1	0.1
2	0.1	0.2	0.2	0.2	0.1	0.1
3	0.1	0.1	0.1	0.1	0.1	0.1
4	0.1	0.1	0.1	0.1	0.1	0.1
5	<0.1	0.1	0.1	0.1	<0.1	<0.1
6	0.2	0.2	0.2	0.2	0.1	0.1
7	0.2	0.2	0.2	0.2	0.2	0.1
8	0.5	0.7	0.6	0.6	0.4	0.4
9	0.2	0.2	0.3	0.3	0.2	0.2
10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
11	0.2	0.2	0.3	0.3	0.2	0.2
12	0.1	0.1	0.2	0.2	0.1	0.1
13	0.1	0.2	0.2	0.2	0.1	0.1
14	0.1	0.1	0.1	0.1	0.1	0.1
15	0.4	0.4	0.4	0.4	0.3	0.3
16	0.4	0.5	0.5	0.5	0.3	0.3
17	0.3	0.3	0.4	0.4	0.2	0.2
18	0.1	0.1	0.1	0.1	0.1	0.1
19	0.3	0.3	0.4	0.3	0.2	0.2

20	0.1	0.2	0.2	0.2	0.1	0.1
21	0.1	0.1	0.2	0.1	0.1	0.1
22	0.1	0.1	0.1	0.1	<0.1	<0.1
23	0.2	0.2	0.2	0.2	0.1	0.1
24	0.1	0.1	0.1	0.1	0.1	0.1
25	0.1	0.1	0.1	0.1	<0.1	<0.1
26	0.2	0.2	0.3	0.3	0.2	0.2
27	0.1	0.1	0.2	0.2	0.1	0.1
28	0.2	0.3	0.3	0.4	0.2	0.2
29	0.1	0.1	0.2	0.2	0.1	0.1
30	0.2	0.2	0.2	0.3	0.2	0.2
31	0.2	0.2	0.2	0.2	0.1	0.1
32	0.3	0.3	0.3	0.3	0.2	0.2
33	0.2	0.2	0.2	0.2	0.1	0.1
34	0.5	0.5	0.6	0.6	0.4	0.4
35	0.2	0.3	0.3	0.3	0.2	0.2
36	0.3	0.3	0.4	0.3	0.2	0.2
37	0.1	0.1	0.1	0.1	<0.1	<0.1
38	0.1	0.1	0.1	0.1	0.1	0.1
39	0.3	0.4	0.4	0.4	0.3	0.3
40	0.3	0.3	0.3	0.3	0.2	0.2
41	0.1	0.1	0.1	0.1	0.1	0.1
42	0.2	0.2	0.2	0.3	0.2	0.2
43	0.1	0.1	0.1	0.1	0.1	0.1
44	0.1	0.1	0.1	0.1	0.1	0.1
45	0.1	0.1	0.1	0.1	0.1	0.1
46	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
47	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
48	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
49	0.1	0.1	0.1	0.1	0.1	0.1
50	0.1	0.1	0.1	0.1	0.1	0.1
51	<0.1	<0.1	0.1	0.1	<0.1	<0.1
52	0.2	0.2	0.2	0.2	0.1	0.1

[a] Receptors modelled at a height of 1.5 m.

Appendix 10B / 10C. Air Quality Appendices

Document Classification: Class 1 - General

Appendix B Detailed Model Prediction – Future Years

Table B- 1: NO_2 Annual Mean Concentrations At Selected Receptor Locations In Future Scenarios (µg/m^3)

Receptor ID	X	Y	Z	2022 Permitted	2022 Proposed	2022 Change (% of AQAL)	2022 Impact Descriptor*	2025 Permitted	2025 Proposed	2025 Change (% of AQAL)	2025 Impact Descriptor*	2035 Permitted	2035 Proposed	2035 Change	2035 Impact Descriptor*
R1	318798	243360	1.5	20.2	20.3	0	N	19.8	19.9	0	N	17.8	17.8	0	NC
R2	319033	244780	1.5	21.8	22.1	1	N	21.3	21.5	0	N	19	19.1	0	N
R3	318630	242250	1.5	18.3	18.4	0	N	17.3	17.4	0	N	15.6	15.6	0	NC
R4	317726	241372	1.5	22.4	22.4	0	N	21.2	21.2	0	N	18.3	18.2	0	N
R5	313514	241030	1.5	27.2	27.3	0	N	25.8	25.9	0	N	21.3	21.3	0	NC
R6	315562	242290	1.5	20.1	20.1	0	N	19.6	19.5	0	N	17.9	17.8	0	N
R7	317519	242579	1.5	21.3	21.3	0	N	20.8	20.9	0	N	18.9	18.9	0	N
R8	317729	243939	4.5	24.6	25.3	2	N	25.8	26.2	1	N	24.6	24.7	0	N
R9	315763	244749	1.5	20.3	20.7	1	N	20.5	20.9	1	N	19.9	20.1	0	N
R10	323880	243429	1.5	15.1	15.1	0	N	13.8	13.8	0	N	12.9	12.9	0	N
R11	313298	244155	1.5	16.9	17.1	0	N	16.5	16.8	1	N	15.9	16	0	N
R12	312909	244952	1.5	16.1	16.2	0	N	15.2	15.4	0	N	14.5	14.5	0	N
R13	312469	244492	1.5	16.0	16.2	0	N	15.2	15.3	0	N	14.4	14.5	0	N
R14	311160	244610	1.5	15.3	15.4	0	N	14.2	14.2	0	N	13.4	13.4	0	N
R15	318102	244515	1.5	20.2	20.8	2	N	20.7	21.0	1	N	20.0	20.2	0	N
R16	317888	243916	1.5	21.2	21.7	1	N	21.9	22.2	1	N	21.1	21.1	0	N
R17	318032	243850	1.5	20.2	20.6	1	N	20.5	20.8	1	N	19.6	19.6	0	N
R18	320013	243349	1.5	16.2	16.3	0	N	15.2	15.3	0	N	14.2	14.2	0	N
R19	312827	243360	1.5	17.0	17.3	1	N	16.8	16.8	0	N	16.0	16.1	0	N
R20	312430	243045	1.5	16.3	16.4	0	N	15.5	15.6	0	N	14.7	14.7	0	N
R21	312467	242503	1.5	16.1	16.1	0	N	15.1	15.1	0	N	14.2	14.2	0	NC
R22	311268	242704	1.5	15.3	15.3	0	N	14.1	14.1	0	N	13.2	13.2	0	NC
R23	317492	242531	1.5	20.0	20.0	0	NC	19.5	19.6	0	N	17.9	17.9	0	N
R24	318874	242268	1.5	17.3	17.3	0	N	16.2	16.3	0	N	14.8	14.8	0	N
R25	319541	242373	1.5	16.2	16.2	0	N	15.1	15.1	0	N	14.0	14.0	0	N
R26	313730	243918	1.5	17.2	17.4	1	N	17.2	17.5	1	N	16.7	16.8	0	N
R27	314205	243834	1.5	16.8	17.0	0	N	16.5	16.7	1	N	15.9	15.9	0	N
R28	313642	243728	1.5	17.7	17.9	1	N	17.7	17.9	0	N	17.1	17.2	0	N
R29	314338	243623	1.5	17.0	17.2	0	N	16.7	16.8	0	N	16.0	16.0	0	N
R30	313862	243591	1.5	17.5	17.8	1	N	17.6	17.7	0	N	17.0	17.0	0	N
R31	315095	244802	1.5	16.7	16.8	0	N	16.1	16.4	1	N	15.6	15.6	0	N
R32	316326	244488	1.5	23.8	24.8	3	N	25.5	26.1	2	N	25.5	25.8	1	N
R33	315883	242339	1.5	18.5	18.3	-1	N	18.1	18.1	0	N	16.9	16.7	0	N
R34	313373	242465	1.5	19.6	19.9	1	N	20.2	19.8	-1	N	19.3	19.3	0	N

Receptor ID	X	Y	Z	2022				2025				2035			
				Permitted	Proposed	Change (% of AQAL)	Impact Descriptor*	Permitted	Proposed	Change (% of AQAL)	Impact Descriptor*	Permitted	Proposed	Change	Impact Descriptor*
R35	312699	243059	1.5	16.8	17.0	1	N	16.4	16.4	0	N	15.6	15.6	0	N
R36	314546	243128	1.5	19.1	19.4	1	N	19.7	19.6	0	N	19.0	19.0	0	NC
R37	317082	240657	1.5	15.8	15.8	0	N	14.5	14.6	0	N	13.5	13.5	0	N
R38	311841	243162	1.5	15.7	15.8	0	N	14.7	14.7	0	N	13.8	13.8	0	N
R39	313017	243550	1.5	17.6	17.9	1	N	17.5	17.6	0	N	16.7	16.8	0	N
R40	315404	243316	1.5	18.3	18.3	0	N	18.3	18.3	0	N	17.5	17.4	0	N
R41	316456	245336	1.5	17.0	17.3	1	N	16.5	16.7	0	N	15.9	15.9	0	N
R42	317203	245096	1.5	18.8	19.3	1	N	19.0	19.3	1	N	18.5	18.7	0	N
R43	313483	246051	1.5	15.6	15.7	0	N	14.6	14.7	0	N	13.9	13.9	0	N
R44	316850	246041	1.5	16.1	16.3	0	N	15.3	15.4	0	N	14.5	14.5	0	N
R45	319651	245565	1.5	16.8	17.0	0	N	15.9	16.1	0	N	14.9	15.0	0	N
R46	321294	242722	1.5	15.4	15.5	0	N	14.2	14.3	0	N	13.3	13.3	0	N
R47	319361	240790	1.5	15.3	15.4	0	NC	14.1	14.1	0	N	13.1	13.1	0	NC
R48	315022	240425	1.5	15.4	15.4	0	N	14.1	14.1	0	N	13.1	13.1	0	NC
R49	316502	241030	1.5	16.5	16.5	0	N	15.3	15.3	0	N	14.1	14.1	0	N
R50	315409	246163	1.5	15.6	15.7	0	N	14.5	14.6	0	N	13.7	13.7	0	N
R51	313841	241050	1.5	23.2	23.3	0	N	21.9	21.9	0	N	18.6	18.6	0	NC
R52	318690	244991	1.5	18.3	18.6	1	N	17.9	18.1	1	N	16.9	16.9	0	N

**N: Negligible, NC: No Change*

Source: AQC (2021) - Dublin Airport North Runway: Relevant Action Application - Technical Report

Table B- 2: PM_{10} Annual Mean Concentrations At Selected Receptor Locations In Future Scenarios (µg/m³)

Receptor ID	X	Y	Z	2022				2025				2035			
				Permitted	Proposed	Change (% of AQAL)	Impact Descriptor*	Permitted	Proposed	Change (% of AQAL)	Impact Descriptor*	Permitted	Proposed	Change (% of AQAL)	Impact Descriptor*
R1	318798	243360	1.5	10.8	10.8	0	N	10.6	10.6	0	N	10.5	10.5	0	N
R2	319033	244780	1.5	10.8	10.8	0	N	10.6	10.6	0	N	10.5	10.5	0	N
R3	318630	242250	1.5	10.7	10.7	0	N	10.4	10.4	0	N	10.3	10.3	0	N
R4	317726	241372	1.5	10.9	10.9	0	N	10.7	10.7	0	N	10.6	10.6	0	N
R5	313514	241030	1.5	11.1	11.1	0	N	10.9	10.9	0	N	10.9	10.9	0	N
R6	315562	242290	1.5	10.9	10.9	0	N	10.7	10.7	0	N	10.6	10.6	0	N
R7	317519	242579	1.5	11.0	11.0	0	N	10.8	10.8	0	N	10.7	10.7	0	N
R8	317729	243939	4.5	11.0	11.1	0	N	10.9	10.9	0	N	10.8	10.8	0	N
R9	315763	244749	1.5	10.8	10.8	0	N	10.6	10.6	0	N	10.5	10.5	0	N
R10	323880	243429	1.5	10.5	10.5	0	N	10.2	10.2	0	N	10.1	10.1	0	N
R11	313298	244155	1.5	10.6	10.6	0	N	10.3	10.3	0	N	10.2	10.2	0	N
R12	312909	244952	1.5	10.6	10.6	0	N	10.3	10.3	0	N	10.2	10.2	0	N
R13	312469	244492	1.5	10.6	10.6	0	N	10.3	10.3	0	N	10.2	10.2	0	N
R14	311160	244610	1.5	10.6	10.6	0	N	10.2	10.2	0	N	10.2	10.2	0	N
R15	318102	244515	1.5	10.7	10.8	0	N	10.5	10.5	0	N	10.3	10.3	0	N
R16	317888	243916	1.5	10.8	10.8	0	N	10.6	10.6	0	N	10.5	10.5	0	N
R17	318032	243850	1.5	10.8	10.8	0	N	10.5	10.5	0	N	10.4	10.4	0	N
R18	320013	243349	1.5	10.6	10.6	0	N	10.3	10.3	0	N	10.2	10.2	0	N
R19	312827	243360	1.5	10.6	10.6	0	N	10.3	10.3	0	N	10.2	10.2	0	N
R20	312430	243045	1.5	10.6	10.6	0	N	10.3	10.3	0	N	10.2	10.2	0	N
R21	312467	242503	1.5	10.6	10.6	0	N	10.3	10.3	0	N	10.2	10.2	0	N
R22	311268	242704	1.5	10.6	10.6	0	N	10.2	10.2	0	N	10.1	10.1	0	N
R23	317492	242531	1.5	10.9	10.9	0	N	10.6	10.6	0	N	10.6	10.6	0	N
R24	318874	242268	1.5	10.6	10.7	0	N	10.4	10.4	0	N	10.3	10.3	0	N
R25	319541	242373	1.5	10.6	10.6	0	N	10.3	10.3	0	N	10.2	10.2	0	N
R26	313730	243918	1.5	10.6	10.6	0	N	10.3	10.3	0	N	10.2	10.2	0	N
R27	314205	243834	1.5	10.6	10.6	0	N	10.3	10.3	0	N	10.2	10.2	0	N
R28	313642	243728	1.5	10.6	10.6	0	N	10.3	10.4	0	N	10.2	10.2	0	N
R29	314338	243623	1.5	10.6	10.6	0	N	10.3	10.4	0	N	10.2	10.2	0	N
R30	313862	243591	1.5	10.6	10.6	0	N	10.4	10.4	0	N	10.2	10.2	0	N
R31	315095	244802	1.5	10.7	10.7	0	N	10.4	10.4	0	N	10.3	10.3	0	N
R32	316326	244488	1.5	10.9	10.9	0	N	10.7	10.7	0	N	10.4	10.4	0	N
R33	315883	242339	1.5	10.8	10.8	0	N	10.6	10.6	0	N	10.5	10.5	0	N
R34	313373	242465	1.5	10.7	10.7	0	N	10.4	10.4	0	N	10.2	10.2	0	N
R35	312699	243059	1.5	10.6	10.6	0	N	10.3	10.3	0	N	10.2	10.2	0	N
R36	314546	243128	1.5	10.7	10.7	0	N	10.5	10.5	0	N	10.3	10.3	0	N
R37	317082	240657	1.5	10.6	10.6	0	N	10.3	10.3	0	N	10.2	10.2	0	N
R38	311841	243162	1.5	10.6	10.6	0	N	10.3	10.3	0	N	10.2	10.2	0	N

Receptor ID	X	Y	Z	2022				2025				2035			
				Permitted	Proposed	Change (% of AQAL)	Impact Descriptor*	Permitted	Proposed	Change (% of AQAL)	Impact Descriptor*	Permitted	Proposed	Change (% of AQAL)	Impact Descriptor*
R39	313017	243550	1.5	10.6	10.6	0	N	10.3	10.3	0	N	10.2	10.2	0	N
R40	315404	243316	1.5	10.8	10.8	0	N	10.5	10.5	0	N	10.4	10.4	0	N
R41	316456	245336	1.5	10.6	10.6	0	N	10.3	10.3	0	N	10.2	10.2	0	N
R42	317203	245096	1.5	10.7	10.7	0	N	10.4	10.4	0	N	10.3	10.3	0	N
R43	313483	246051	1.5	10.6	10.6	0	N	10.3	10.3	0	N	10.2	10.2	0	N
R44	316850	246041	1.5	10.6	10.6	0	N	10.3	10.3	0	N	10.2	10.2	0	N
R45	319651	245565	1.5	10.6	10.6	0	N	10.3	10.3	0	N	10.2	10.2	0	N
R46	321294	242722	1.5	10.6	10.6	0	N	10.3	10.3	0	N	10.2	10.2	0	N
R47	319361	240790	1.5	10.6	10.6	0	N	10.3	10.3	0	N	10.2	10.2	0	N
R48	315022	240425	1.5	10.8	10.8	0	N	10.3	10.3	0	N	10.2	10.2	0	N
R49	316502	241030	1.5	10.8	10.8	0	N	10.3	10.3	0	N	10.2	10.2	0	N
R50	315409	246163	1.5	10.7	10.7	0	N	10.3	10.3	0	N	10.2	10.2	0	N
R51	313841	241050	1.5	10.9	10.9	0	N	10.7	10.7	0	N	10.6	10.6	0	N
R52	318690	244991	1.5	11.1	11.1	0	N	10.4	10.4	0	N	10.3	10.3	0	N

*N: Negligible

Source: AQC (2021) - Dublin Airport North Runway: Relevant Action Application - Technical Report

Table B- 3: $PM_{2.5}$ Annual Mean Concentrations At Selected Receptor Locations In Future Scenarios (µg/m³)

Receptor ID	X	Y	Z	2022				2025				2035			
				Permitted	Proposed	Change (% of AQAL)	Impact Descriptor*	Permitted	Proposed	Change (% of AQAL)	Impact Descriptor*	Permitted	Proposed	Change (% of AQAL)	Impact Descriptor*
R1	318798	243360	1.5	6.6	6.6	0	N	6.4	6.4	0	N	6.3	6.3	0	N
R2	319033	244780	1.5	6.6	6.6	0	N	6.4	6.4	0	N	6.3	6.3	0	N
R3	318630	242250	1.5	6.5	6.5	0	N	6.3	6.3	0	N	6.2	6.2	0	N
R4	317726	241372	1.5	6.6	6.6	0	N	6.4	6.4	0	N	6.4	6.4	0	N
R5	313514	241030	1.5	6.8	6.8	0	N	6.6	6.6	0	N	6.5	6.5	0	N
R6	315562	242290	1.5	6.7	6.7	0	N	6.5	6.5	0	N	6.4	6.4	0	N
R7	317519	242579	1.5	6.7	6.7	0	N	6.5	6.5	0	N	6.4	6.4	0	N
R8	317729	243939	4.5	6.8	6.8	0	N	6.7	6.7	0	N	6.5	6.5	0	N
R9	315763	244749	1.5	6.6	6.7	0	N	6.4	6.5	0	N	6.3	6.3	0	N
R10	323880	243429	1.5	6.4	6.4	0	N	6.1	6.1	0	N	6.1	6.1	0	N
R11	313298	244155	1.5	6.5	6.5	0	N	6.2	6.2	0	N	6.1	6.1	0	N
R12	312909	244952	1.5	6.4	6.4	0	N	6.2	6.2	0	N	6.1	6.1	0	N
R13	312469	244492	1.5	6.4	6.4	0	N	6.2	6.2	0	N	6.1	6.1	0	N
R14	311160	244610	1.5	6.4	6.4	0	N	6.2	6.2	0	N	6.1	6.1	0	N
R15	318102	244515	1.5	6.6	6.6	0	N	6.4	6.4	0	N	6.2	6.2	0	N
R16	317888	243916	1.5	6.6	6.7	0	N	6.5	6.5	0	N	6.3	6.3	0	N
R17	318032	243850	1.5	6.6	6.6	0	N	6.4	6.4	0	N	6.3	6.3	0	N
R18	320013	243349	1.5	6.4	6.4	0	N	6.2	6.2	0	N	6.1	6.1	0	N
R19	312827	243360	1.5	6.5	6.5	0	N	6.2	6.2	0	N	6.1	6.1	0	N
R20	312430	243045	1.5	6.4	6.4	0	N	6.2	6.2	0	N	6.1	6.1	0	N
R21	312467	242503	1.5	6.4	6.4	0	N	6.2	6.2	0	N	6.1	6.1	0	N
R22	311268	242704	1.5	6.4	6.4	0	N	6.1	6.1	0	N	6.1	6.1	0	N
R23	317492	242531	1.5	6.6	6.6	0	N	6.4	6.4	0	N	6.3	6.3	0	N
R24	318874	242268	1.5	6.5	6.5	0	N	6.2	6.2	0	N	6.2	6.2	0	N
R25	319541	242373	1.5	6.4	6.4	0	N	6.2	6.2	0	N	6.1	6.1	0	N
R26	313730	243918	1.5	6.5	6.5	0	N	6.2	6.3	0	N	6.1	6.1	0	N
R27	314205	243834	1.5	6.5	6.5	0	N	6.2	6.2	0	N	6.1	6.1	0	N
R28	313642	243728	1.5	6.5	6.5	0	N	6.3	6.3	0	N	6.1	6.1	0	N
R29	314338	243623	1.5	6.5	6.5	0	N	6.2	6.3	0	N	6.1	6.1	0	N
R30	313862	243591	1.5	6.5	6.5	0	N	6.3	6.3	0	N	6.1	6.1	0	N
R31	315095	244802	1.5	6.5	6.5	0	N	6.3	6.3	0	N	6.2	6.2	0	N
R32	316326	244488	1.5	6.7	6.8	0	N	6.5	6.6	0	N	6.3	6.3	0	N
R33	315883	242339	1.5	6.6	6.6	0	N	6.4	6.4	0	N	6.3	6.3	0	N
R34	313373	242465	1.5	6.5	6.5	0	N	6.3	6.3	0	N	6.1	6.1	0	N
R35	312699	243059	1.5	6.5	6.5	0	N	6.2	6.2	0	N	6.1	6.1	0	N
R36	314546	243128	1.5	6.6	6.6	0	N	6.4	6.4	0	N	6.2	6.2	0	N
R37	317082	240657	1.5	6.4	6.4	0	N	6.2	6.2	0	N	6.1	6.1	0	N
R38	311841	243162	1.5	6.4	6.4	0	N	6.2	6.2	0	N	6.1	6.1	0	N

Receptor ID	X	Y	Z	2022				2025				2035			
				Permitted	Proposed	Change (% of AQAL)	Impact Descriptor*	Permitted	Proposed	Change (% of AQAL)	Impact Descriptor*	Permitted	Proposed	Change (% of AQAL)	Impact Descriptor*
R39	313017	243550	1.5	6.5	6.5	0	N	6.2	6.2	0	N	6.1	6.1	0	N
R40	315404	243316	1.5	6.6	6.6	0	N	6.4	6.4	0	N	6.3	6.3	0	N
R41	316456	245336	1.5	6.5	6.5	0	N	6.2	6.2	0	N	6.1	6.1	0	N
R42	317203	245096	1.5	6.5	6.5	0	N	6.3	6.3	0	N	6.2	6.2	0	N
R43	313483	246051	1.5	6.4	6.4	0	N	6.2	6.2	0	N	6.1	6.1	0	N
R44	316850	246041	1.5	6.4	6.4	0	N	6.2	6.2	0	N	6.1	6.1	0	N
R45	319651	245565	1.5	6.5	6.5	0	N	6.2	6.2	0	N	6.1	6.1	0	N
R46	321294	242722	1.5	6.4	6.4	0	N	6.2	6.2	0	N	6.1	6.1	0	N
R47	319361	240790	1.5	6.4	6.4	0	N	6.2	6.2	0	N	6.1	6.1	0	N
R48	315022	240425	1.5	6.4	6.4	0	N	6.2	6.2	0	N	6.1	6.1	0	N
R49	316502	241030	1.5	6.5	6.5	0	N	6.2	6.2	0	N	6.1	6.1	0	N
R50	315409	246163	1.5	6.4	6.4	0	N	6.2	6.2	0	N	6.1	6.1	0	N
R51	313841	241050	1.5	6.6	6.6	0	N	6.4	6.4	0	N	6.4	6.4	0	N
R52	318690	244991	1.5	6.5	6.5	0	N	6.3	6.3	0	N	6.2	6.2	0	N

*N: Negligible

Source: AQC (2021) - Dublin Airport North Runway: Relevant Action Application - Technical Report

Appendix C Detailed Model Prediction - Odour

Table C- 1: Modelled Odour Levels Across The Selected Receptors

Receptor ID	Odour (OUe/m^3) - 98th percentile					
	2022		2025		2035	
	Baseline (Permitted without Relevant Action)	Proposed (with Relevant Action)	Baseline (Permitted without Relevant Action)	Proposed (with Relevant Action)	Baseline (Permitted without Relevant Action)	Proposed (with Relevant Action)
R1	0.1	0.1	0.1	0.1	0.1	0.1
R2	0.1	0.2	0.2	0.2	0.1	0.1
R3	0.1	0.1	0.1	0.1	0.1	0.1
R4	0.1	0.1	0.1	0.1	0.1	0.1
R5	<0.1	0.1	0.1	0.1	<0.1	<0.1
R6	0.2	0.2	0.2	0.2	0.1	0.1
R7	0.2	0.2	0.2	0.2	0.2	0.1
R8	0.5	0.7	0.6	0.6	0.4	0.4
R9	0.2	0.2	0.3	0.3	0.2	0.2
R10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
R11	0.2	0.2	0.3	0.3	0.2	0.2
R12	0.1	0.1	0.2	0.2	0.1	0.1
R13	0.1	0.2	0.2	0.2	0.1	0.1
R14	0.1	0.1	0.1	0.1	0.1	0.1
R15	0.4	0.4	0.4	0.4	0.3	0.3
R16	0.4	0.5	0.5	0.5	0.3	0.3
R17	0.3	0.3	0.4	0.4	0.2	0.2
R18	0.1	0.1	0.1	0.1	0.1	0.1
R19	0.3	0.3	0.4	0.3	0.2	0.2
R20	0.1	0.2	0.2	0.2	0.1	0.1
R21	0.1	0.1	0.2	0.1	0.1	0.1
R22	0.1	0.1	0.1	0.1	<0.1	<0.1
R23	0.2	0.2	0.2	0.2	0.1	0.1
R24	0.1	0.1	0.1	0.1	0.1	0.1
R25	0.1	0.1	0.1	0.1	<0.1	<0.1
R26	0.2	0.2	0.3	0.3	0.2	0.2
R27	0.1	0.1	0.2	0.2	0.1	0.1
R28	0.2	0.3	0.3	0.4	0.2	0.2
R29	0.1	0.1	0.2	0.2	0.1	0.1
R30	0.2	0.2	0.2	0.3	0.2	0.2
R31	0.2	0.2	0.2	0.2	0.1	0.1
R32	0.3	0.3	0.3	0.3	0.2	0.2
R33	0.2	0.2	0.2	0.2	0.1	0.1
R34	0.5	0.5	0.6	0.6	0.4	0.4
R35	0.2	0.3	0.3	0.3	0.2	0.2
R36	0.3	0.3	0.4	0.3	0.2	0.2

Receptor ID	Odour (OUe/m^3) - 98th percentile					
	2022		2025		2035	
	Baseline (Permitted without Relevant Action)	Proposed (with Relevant Action)	Baseline (Permitted without Relevant Action)	Proposed (with Relevant Action)	Baseline (Permitted without Relevant Action)	Proposed (with Relevant Action)
R37	0.1	0.1	0.1	0.1	<0.1	<0.1
R38	0.1	0.1	0.1	0.1	0.1	0.1
R39	0.3	0.4	0.4	0.4	0.3	0.3
R40	0.3	0.3	0.3	0.3	0.2	0.2
R41	0.1	0.1	0.1	0.1	0.1	0.1
R42	0.2	0.2	0.2	0.3	0.2	0.2
R43	0.1	0.1	0.1	0.1	0.1	0.1
R44	0.1	0.1	0.1	0.1	0.1	0.1
R45	0.1	0.1	0.1	0.1	0.1	0.1
R46	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
R47	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
R48	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
R49	0.1	0.1	0.1	0.1	0.1	0.1
R50	0.1	0.1	0.1	0.1	0.1	0.1
R51	<0.1	<0.1	0.1	0.1	<0.1	<0.1
R52	0.2	0.2	0.2	0.2	0.1	0.1

Source: AQC (2021) - Dublin Airport North Runway: Relevant Action Application - Technical Report

Appendix 11A. Aircraft Model Substitutions

Document Classification: Class 1 - General

Appendix 11A Required Aircraft Model Substitutions

11.1.1 As outlined in Chapter 11 Climate and Carbon, some aircraft models listed within the aircraft schedule developed by Mott MacDonald[1] were not available within the Aviation Emissions Calculator[2] or the Atmosfair Flight Emissions Calculator[3], which were used to calculate GHG emissions associated with Air Traffic Movements (ATMs). In these instances, the closest available model produced by the same manufacturer was selected as a proxy.

11.1.2 All substitutions made are outlined in Table 1 below. These substitutions are considered to represent a conservative approach as, generally, the aircraft models which were not available in the emissions calculators are newer, more efficient models. Therefore, less efficient models have generally been used to calculate GHG emissions associated with these aircraft types.

Table 1: Aircraft model substitutions made within the GHG calculations

Aircraft model listed in the aircraft schedule	Aircraft model used as a proxy
Airbus A220-300	Airbus A318
Airbus A330 Freighter	Airbus A332
Airbus A330neo -900	Airbus A333
Airbus A350-900	Airbus A350
Airbus A380-800	Airbus A380
Avions de Transport Regional ATR-43	Avions de Transport Regional ATR-42
Boeing 737 Max 8	Boeing 737
Boeing 738 Freighter	Boeing 738
Boeing 777-9	Boeing 777-300ER
Boeing 777-200LR	Boeing 777-200
Boeing 787-10	Boeing 787-900
De Havilland Canada DH8D	De Havilland Canada DH8
Embraer E190-E2	Embraer E-190

[1] Mott MacDonald, (2021); Dublin Airport Operating Restrictions: Quantification of Impacts on Future Growth May 2021 Update – 2022-2025 Period
[2] EMEP/ EEA, (2019); Aviation Emissions Calculator (accompaniment to the EMEP/ EEA air pollutant emission inventory guidebook, 2019, chapter 1.A.3.a Aviation)
[3] Atmosfair, (2020); Calculate Flight Emissions [online]. Available at: https://www.atmosfair.de/en/offset/flight/

Document Classification: Class 1 - General

Appendix 13A. Air Noise Legislation and Guidance

Document Classification: Class 1 - General

13A. Legislation, policy, technical guidelines and assessment criteria relevant to air noise and vibration

13A.1 Introduction

13A.1.1 This appendix of the Environmental Impact Assessment Report (EIAR), prepared by Bickerdike Allen Partners LLP, sets out details of the legislation and planning policy considered relevant to the assessment.

13A.1.2 Chapter 6 of the EIAR contains details of the strategic planning context, national planning policy, and local planning policy. Further details of the strategic planning context are given in Section 13A.2. Relevant UK policy, standards and guidance are considered in Section 13A.4, and other international policy, standards and guidance in Section 13A.3.

13A.1.3 There are various noise metrics available for the assessment of the impacts of air noise. These are described in detail in Section 13A.5.

13A.1.4 The derivation of the effect scales used in the air noise assessment are discussed in Section 13A.6.

13A.2 Strategic Planning Context

S.I. No. 549/2018 – Environmental Noise Regulations 2018

13A.2.1 This Statutory Instrument gives effect to Directive (EC) 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise, as amended by Commission Directive (EU) 2015/996 of 19 May 2015 establishing common noise assessment methods.

13A.2.2 The regulations are to be known as the European Communities (Environmental Noise) Regulations 2018 and came into operation on the 31 December 2018. They require the production of strategic noise maps for set agglomerations, major roads, major railways, and major airports. They also require the production of subsequent action plans.

EU Regulation 598/2014

13A.2.3 The European Commission introduced EU Regulation 598/2014[1] in 2016 to account for developments in the aviation world. This repeals 2002/30/EC[2] which set out procedures and rules for the introduction of noise related operating restrictions to the busiest of the European airports. This previous regime for managing airport noise placed the responsibility with the airport operator. The entry into force in 2016 of EU Regulation 598/2014 represents a shift in responsibility from the airport operator to a separate, independent statutory entity or competent authority to oversee the delivery of the new, more prescriptive approach to airport noise management.

13A.2.4 There are seven key elements of the new regulatory regime which are:

- Designation of a separate, independent statutory entity as the Competent Authority;
- Appropriate collaborative working arrangements;

[1] European Commission (2014). Regulation (EU) No 598/2014 of the European Parliament and of the Council of 16 April 2014 on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Union airports within a Balanced Approach and repealing Directive 2002/30/EC, [online]. Available at: https://publications.europa.eu/en/publication-detail/-/publication/b6947ca7-f1f6-11e3-8cd4-01aa75ed71a1/language-en [Checked 16/08/2021].

[2] European Commission (2002), Directive 2002/30/EC Directive of the European Parliament and the Council of 26th March 2002 on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Community airports [online]. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32002L0030&from=EN [Checked 16/08/2021].

- Robust consultation requirements;
- Adherence to the ICAO Balanced Approach;
- Compliance with Environmental Impact Assessment (EIA), Habitats & Birds, and the Environmental Noise Directives;
- Establishment of an appropriate, robust appeal mechanism, and
- Ongoing monitoring and enforcement activities.

13A.2.5 Regulation (EU) No 598/2014 under Article 5 requires that member states shall ensure that the Balanced Approach is adopted in respect of aircraft noise management at those airports where a noise problem has been identified. To that end, they shall ensure that the Noise Abatement Objective (NAO) for that airport is defined. This then allows the measures available to reduce the noise impact to be identified, and the likely cost-effectiveness of the noise mitigation measures to be thoroughly evaluated.

Aircraft Noise (Dublin Airport) Regulation Act, 2019

13A.2.6 The Aircraft Noise (Dublin Airport) Regulation Act 2019 (The Aircraft Noise Act) implements EU Regulation 598/2014 on the establishment of rules and procedures with regard to the introduction of noise related operating restrictions at European Union Airports within the Balanced Approach.

13A.2.7 The Aircraft Noise Act amends the Planning and Development Act 2000 as amended (PDA), to cater for the situation where development at Dublin Airport may give rise to an aircraft noise problem and where an airport wishes to apply to revoke, amend or replace operating restrictions at the airport.

13A.2.8 The Aircraft Noise Act was enacted on 22nd May 2019. It was subsequently amended on 1st September 2019, following the removal of Airport infrastructure from the Seventh Schedule of the PDA and thus the strategic infrastructure development planning process is no longer applicable to it.

13A.2.9 Fingal County Council has been designated as the competent authority for the purposes of aircraft noise regulation at Dublin Airport by section 3(1) of the Aircraft Noise (Dublin Airport) Regulation Act 2019.

13A.2.10 The Aircraft Noise Act amends the PDA by inserting a number of new sections in Part 3 of the PDA, which deals with control of development. These sections introduce a number of new measures for planning applications at Dublin Airport that may necessitate noise-related actions or that may require a new operating restriction.

13A.2.11 Section 34C of the PDA permits an applicant who is currently subject to a planning permission for development at the airport, that includes an operating restriction, to make an application under Section 34 of the PDA to revoke, amend, replace or take other action in respect of the operating restriction. Pursuant to Section 34C (23) of the PDA this is defined as a proposed ‘Relevant Action’. In this regard, daa is enabled to make this application for a proposed relevant action as it seeks to make changes to the operating restrictions imposed by the North Runway Permission.

13A.3 International Policy, Standards and Guidance

ICAO Balanced Approach

13A.3.1 The International Civil Aviation Organisation (ICAO) is the inter-governmental body that oversees the worldwide civil aviation industry. ICAO has adopted a set of principles and guidance, constituting the ‘balanced approach’ to aircraft noise management, which encourages ICAO member states to address the following points:

13A.3.2 Mitigate aviation noise through selection at a local level of the optimum combination of four key measures;

- Reducing noise at source (from use of quieter aircraft);
- Making best use of land (plan and manage the land surrounding airports);

- Introducing operational noise abatement procedures (by using specific runways, routes or procedures);
- Imposing noise-related operating restrictions (such as a night time operating ban or phasing out of noisier aircraft);

13A.3.3 Select the most cost-effective range of measures; and

13A.3.4 Not introduce noise-related operating restrictions unless the authority is in a position, on the basis of studies and consultations, to determine whether a noise problem exists and having determined that an operating restriction is a cost-effective way of dealing with the problem.

13A.3.5 As detailed in the ANCA report titled Aircraft Noise Mitigation at Dublin Airport, the Balanced Approach to aircraft noise management is an internationally agreed approach to managing noise at large airports. Noise reduction is explored through four principal elements with the objective to address noise problems in the most cost-effective manner, and only apply operating restrictions as a last resort measure.

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

13A.3.6 ICAO has set a number of standards for aircraft noise certification which are contained in Volume 1 of Annex 16 to the Convention on International Civil Aviation[3]. This document sets maximum acceptable noise levels for different aircraft during take-off and landing, categorised for subsonic jet aeroplanes as Chapter 2, 3, 4 and 14.

13A.3.7 Chapter 2 aircraft have been prevented from operating within the EU since 2002, unless they are granted specific exemption, and therefore the vast majority of aircraft fall within Chapter 3, 4 and 14 parameters. These aircraft are quieter than Chapter 2 aircraft.

13A.3.8 Chapter 4 standards have applied to all new aircraft manufactured since 2006. These aircraft must meet a standard of being cumulatively 10 dB quieter than Chapter 3 aircraft.

13A.3.9 Chapter 14 was adopted by the ICAO in 2014. It represents an increase in stringency of 7 dB compared with Chapter 4 and applies to new aircraft submitted for certification after 31st December 2017.

Environmental Noise Directive 2002/49/EC

13A.3.10 The Environmental Noise Directive (END)[4] concerning the assessment and management of environmental noise from transport, came into effect in June 2002. Its aim was to define a common approach across the European Union with the intention of avoiding, preventing or reducing on a prioritised basis the harmful effects, including annoyance, due to exposure to environmental noise. This involves:

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

EU Commission Directive 2020/367

13A.3.11 Commission Directive (EU) 2020/367 of 4 March 2020 amends Annex III to Directive 2002/49/EC of the European Parliament and of the Council as regards the establishment of assessment methods for harmful effects of environmental noise. The amendment is to *Annex III Assessment Methods for Harmful Effects* and includes the introduction of formulae which compute a value for the proportion of a population highly annoyed or highly sleep disturbed from noise from specific sources, including aircraft.

[3] ICAO (2017), Annex 16 to the Convention on International Civil Aviation, Volume 1 8th Edition. ICAO.
[4] European Commission (2002). Directive 2002/49/EC Directive of the European Parliament and of the Council of 25th June 2002 relating to the assessment and management of environmental noise, [online]. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32002L0049&from=EN [Checked 16/08/2021].

WHO Guidelines for community noise (1999)

13A.3.12 WHO Guidelines for Community Noise[5] provide a range of aspirational noise targets aimed at protecting the health and well-being of the community. They therefore set out noise targets which represent goals for minimising the adverse effects of noise on health as opposed to setting absolute noise limits for planning purposes.

13A.3.13 For outside areas of dwellings, the WHO Guidelines state that to protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55 dB L_{Aeq} on balconies, terraces and in outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50 dB L_{Aeq}. Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development. The WHO guidance cites a 16 hour period as applicable to the above limits.

13A.3.14 Although the attainment of these steady noise target values is not always achievable in practice, particularly where a dwelling is located close to a busy road or railway, controlling the daytime noise level to 55 dB $L_{Aeq,16h}$ or below in some gardens and amenity areas can sometimes be achieved for developments near roads and railways by the use of screening achieved using other buildings, fences or purpose made noise barriers.

WHO Night Noise Guidelines for Europe (2009)

13A.3.15 Guidance on absolute noise levels at night are given in by the WHO Night Noise Guidelines (NNG)[6]. These report findings from the WHO concerning night noise from transportation sources and its effects on health and sleep. These guidelines acknowledge that the effect of noise on people at night depends not just on the magnitude of noise of a single event but also the number of events. It considers that in the long term, over a year, these effects can be described using the $L_{night,outside}$ index. This is essentially equivalent to the $L_{Aeq,8h}$ index commonly used in the UK, but instead of being based on aircraft activities during the average summer night, is based on the average annual night.

13A.3.16 These guidelines were prepared by a working group set up to provide scientific advice to the Member States for the development of future legislation and policy action in the area of assessment and control of night noise exposure. The working group reviewed available scientific evidence on the health effects of night noise, and derived health-based guideline values. Although this provides guidance to the European Community in general and has no policy status, it provided a description of then recent research into the health effects of noise and provided guidance on noise targets.

13A.3.17 The following night noise guideline values are recommended by the working group for the protection of public health from night noise:

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

13A.3.18 The NNG is a health based limit to aspire towards whereas the IT represents a feasibility based intermediate target. This is borne out to some extent by the Strategic Noise Mapping work undertaken across European Member States in compliance with the Environmental Noise Directive. For night noise, Member States are required to produce noise maps in terms of the $L_{night,outside}$ index no lower than 50 dB for strategic planning purposes.

13A.3.19 The relationship between night noise exposure and health effects as defined by these WHO guidelines can be summarised as shown in Table 13A-1.

[5] Berglund, B. et al (1999). Guidelines for community noise. [Online]. Available at: http://apps.who.int/iris/bitstream/handle/10665/66217/a68672.pdf?sequence=1&isAllowed=y [Checked: 16/08/2021].
[6] World Health Organisation Europe (2009). Night Noise Guidelines for Europe, [Online]. Available at: http://www.euro.who.int/__data/assets/pdf_file/0017/43316/E92845.pdf [Checked 16/08/2021].

Table 13A-1: WHO guidance on the relationship between night noise exposure and health effects

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

WHO Environmental Noise Guidelines for the European Region (2018)

13A.3.20 In October 2018 the WHO published their updated Environmental Noise Guidelines[7] which contain the following recommendations:

13A.3.21 For average noise exposure, the GDG (Guideline Development Group) strongly recommends reducing noise levels produced by aircraft below 45 dB L_{den}, as aircraft noise above this level is associated with adverse health effects.

13A.3.22 For night noise exposure, the GDG strongly recommends reducing noise levels produced by aircraft during night-time below 40 dB L_{night}, as night-time aircraft noise above this level is associated with adverse effects on sleep.

13A.3.23 These WHO guidelines could not be adopted as thresholds without imposing very significant restrictions on the current permitted operations of most major airports. As an example, even a single Airbus A320 or Boeing 737-800 aircraft operating once per night could expose hundreds of people to noise levels in excess of the guideline 40 dB L_{night} value at an airport in a relatively rural location. 10 aircraft events during the daytime (07:00-19:00) period (or smaller numbers in the evening and night periods) could expose a similar number of people to noise levels in excess of the 45 dB L_{den} parameter.

13A.3.24 These guidelines have not yet been adopted as UK policy, and there is no current indication that they will be. In December 2018, the UK Government published the consultation document Aviation 2050, which included the following regarding the WHO Guidelines:

13A.3.25 "3.106 There is also evidence that the public is becoming more sensitive to aircraft noise, to a greater extent than noise from other transport sources, and that there are health costs associated from exposure to this noise. The government is considering the recent new environmental noise guidelines for the European region published by the World Health Organization (WHO). It agrees with the ambition to reduce noise and to minimise adverse health effects, but it wants policy to be underpinned by the most robust evidence on these effects, including the total cost of an action and recent UK specific evidence which the WHO report did not assess."

13A.4 Relevant UK Policy, Standards and Guidance

Noise Policy Statement for England (2010)

13A.4.1 The Noise Policy Statement for England (NPSE)[8] provides the framework for noise management decisions to be made that ensure noise levels do not place an unacceptable burden on society. The stated aims of the Noise Policy Statement for England are to:

[7] World Health Organization Regional Office for Europe (2018). Environmental Noise Guidelines for the European Region. [Online]. Available at: http://www.euro.who.int/__data/assets/pdf_file/0008/383921/noise-guidelines-eng.pdf [Checked: 16/08/2021].
[8] Defra (2010). Noise Policy Statement for England, [online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69533/pb13750-noise-policy.pdf [Checked 16/08/2021].

13A.4.2 *Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development;*

13A.4.3 *Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development, and*

13A.4.4 *Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.*

13A.4.5 The NPSE introduces the concepts of NOEL (No Observed Effect Level), LOAEL (Lowest Observed Adverse Effect Level) and SOAEL (Significant Observed Adverse Effect Level). The definition of these is as follows:

NOEL – No observed effect level. This is the level below which no effect can be detected;

LOAEL – Lowest observed adverse effect level. This is the level above which adverse effects on health and quality of life can be detected, and

SOAEL – Significant observed adverse effect level. This is the level above which significant adverse effects on health and quality of life occur.

13A.4.6 NPSE states that it is not possible to give a single objective noise-based measure that defines a SOAEL that is applicable to all sources of noise for all situations. It acknowledges that the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It also acknowledges that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise.

13A.4.7 Where any adverse noise effects are predicted, these are identified and if these cannot be avoided, mitigation measures are recommended to ensure no significant residual effects on health and quality of life arise. This approach is considered consistent with the principal aims of the NPSE. It is important to note that findings against the LOAEL and SOAEL are measures of the effect of noise on health and quality of life, and not environmental impact assessment findings.

UK Aviation Policy Framework (2013)

13A.4.8 The Aviation Policy Framework (APF) was published in March 2013[9] by the Department for Transport (DfT). The APF defines the Government's objectives and policies on the impacts of aviation in the UK.

13A.4.9 On managing aviation's environmental impacts, and specifically noise, it states in paragraph 3.12 that the Government's overall objective on noise is to *"Limit and where possible reduce the number of people in the UK significantly affected by aircraft noise"*.

13A.4.10 It goes on in paragraph 3.13 to state that *"This is consistent with the Government's Noise Policy, as set out in the Noise Policy Statement for England (NPSE) which aims to avoid significant adverse impact on health and quality of life."*

13A.4.11 Guidance is provided on the noise metric used to rate airborne noise in paragraph 3.13 where it states *"To provide historic continuity, the Government will continue to ensure that noise exposure maps are produced for the noise-designated airports on an annual basis providing results down to a level of 57 dB LAeq,16hour"*.

13A.4.12 The noise index is described in a footnote as *"the A-weighted average sound level over the 16 hour period of 07:00-23:00. This is based on an average summer day when producing noise contour maps at the designated airports."*

13A.4.13 In paragraph 3.17 the interpretation of the contour is given as *"We will continue to treat the 57 dB LAeq,16h contour as an average level of day time aircraft noise marking the approximate onset of significant community annoyance. However, this does not mean that all people within this contour will*

[9] Department for Transport (2013). Aviation Policy Framework. [online]. Available at: https://www.gov.uk/government/publications/aviation-policy-framework [Checked 16/08/2021].

experience significant adverse effects from aircraft noise. Nor does it mean that no-one outside of this contour will consider themselves annoyed by aircraft noise."

13A.4.14 Under the heading "Noise insulation and compensation" the APF states that:

13A.4.15 "The Government continues to expect airport operators to offer households exposed to levels of noise of 69 dB LAeq,16h or more, assistance with the cost of moving.

13A.4.16 *The Government also expects airport operators to offer acoustic insulation to noise sensitive buildings, such as schools and hospitals, exposed to levels of noise of 63 dB LAeq,16h or more. Where acoustic insulation cannot provide an appropriate or cost-effective solution, alternative mitigation measures should be offered."*

Survey of Noise Attitudes 2014 (2021)

13A.4.17 The Civil Aviation Authority Survey of Noise Attitudes 2014 (or SoNA 2014)[10] includes the results of a survey of noise attitudes to civil aircraft. SoNA 2014 largely replaced Attitudes to noise from aviation sources in England (or ANASE)[11], the last large scale survey on attitudes to aircraft noise published in 2007. The second edition of SoNA was published in 2021 alongside a technical peer review. The overall conclusions of the study remained unchanged compared to the first edition.

13A.4.18 SoNA 2014 compared reported mean annoyance scores against average summer-day noise exposure defined using $L_{Aeq,16h}$, L_{den}, N70 and N65. Mean annoyance score correlated well with average summer day noise exposure, $L_{Aeq,16h}$. No evidence was found to suggest any of the other indicators correlated better with annoyance than $L_{Aeq,16h}$.

13A.4.19 The survey resulted in 54 dB $L_{Aeq,16h}$ becoming the threshold of community annoyance rather than 57 dB $L_{Aeq,16h}$ which was based on the UK Aircraft Noise Index Study (or ANIS) from 1985[12].

UK Airspace Policy: A framework for balanced decisions on the design and use of airspace 2017 consultation

13A.4.20 Although the APF[13] remains the current national aviation policy document, in 2017 the Department for Transport reported on the outcome of consultations regarding changes to UK airspace (Consultation Response on UK Airspace Policy: A framework for balanced decisions on the design and use of airspace) which included a review of criteria and metrics for assessing aircraft noise. This states in paragraph 9: *"The Government's current aviation policy is set out in the Aviation Policy Framework (APF). The policies set out within this document provide an update to some of the policies on aviation noise contained within the APF, and should be viewed as the current government policy. The government also intends to develop aviation noise policy further through the Aviation Strategy consultation process. As part of the Aviation Strategy consultation on sustainable growth planned for 2018 the Government intends to consider the roles, structures and powers that currently exist and what, if any, new ones will be necessary to bring about the network wide, co-ordinated and complex changes needed for airspace modernisation"*.

13A.4.21 Based on this report, the Government will implement a range of proposals of which the key points are:

- The creation of an Independent Commission on Civil Aviation Noise (ICCAN) as an advisory non-departmental public body;

[10] Civil Aviation Authority (2021). CAP1506: Survey of Noise Attitudes 2014: Aircraft Noise and Annoyance, Second Edition, [online]. Available at: CAP1506: Survey of Noise Attitudes 2014: Aircraft Noise and Annoyance, Second Edition (caa.co.uk) [Checked 16/08/2021]
[11] Le Masurier, Paul et al (2007). Attitudes to noise from aviation sources in England (ANASE): Final Report for Department for Transport. Norwich: HMSO.
[12] Brooker et al (1985). United Kingdom Aircraft Noise Study: Main Report, DR Report 8402, Civil Aviation Authority Directorate of Operational Research and Analysis for Department of Transport. London: Civil Aviation Authority.
[13] Department for Transport (2017). Consultation Response on UK Airspace Policy: A framework for balanced decisions on the design and use of airspace. [online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/653801/consultation-response-on-uk-airspace-policy-web-version.pdf [Checked 16/08/2021].

- A level of 54 dB $L_{Aeq,16h}$ is now acknowledged to correspond to the onset of significant community annoyance and replaces the 57 dB $L_{Aeq,16h}$ level in the APF,
- Some adverse effects of annoyance can now be seen to occur down to 51 dB $L_{Aeq,16h}$. A LOAEL of 51 dB $L_{Aeq,16h}$ and 45 dB L_{night}, for daytime and night-time noise respectively, are to be used in assessing and comparing noise impacts of airspace changes (N.B. Following consultation with the CAA, the Government consider it appropriate to use 45 dB $L_{Aeq,8h}$ as the LOAEL for air space change assessment, for consistency with daytime noise).

13A.4.22 As part of this consultation the Department for Transport published their draft Air navigation guidance on airspace and noise management and environmental objectives[14]. This proposes that rather than limiting the number of people exposed to any level of aircraft noise, the number of people experiencing significant adverse effects should be limited.

BS 8233:2014 Sound insulation and noise reduction in buildings – code of practice

13A.4.23 The British Standard BS8233:2014 Sound insulation and noise reduction for buildings – Code of practice[15] provides guidance on the control of external noise. The standard presents a number of design ranges for indoor noise levels for different types of space.

13A.4.24 The internal ambient noise guideline levels for dwellings are given in Table 13A-2.

Table 13A-2: Dwelling noise exposure hierarchy based on the likely average response

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq,16h}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16h}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16h}$	30 dB $L_{Aeq,8h}$

13A.4.25 Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or L_{AFmax}, depending on the character and number of events per night. Sporadic noise events could require separate values.

13A.4.26 These guideline noise levels can be used for rooms for residential purposes including hotels, hostels, halls of residence, school boarding houses, hospices and residential care homes.

13A.4.27 BS8233:2014 also gives guideline ambient noise levels in non-domestic buildings. These are given in Table 13A-3.

Table 13A-3: Non=domestic noise exposure hierarchy based on the likely average response

Activity	Location	Design range $L_{Aeq,T}$ (dB)
Speech or telephone communications	Department store, cafeteria, canteen, kitchen	50 to 55
	Concourse, corridor, circulation space	45 to 55
Study and work requiring concentration	Library, gallery, museum	40 to 50
	Staff/meeting room, training room	35 to 45
	Executive office	35 to 40
Listening	Place of worship, counselling, meditation, relaxation	30 to 35

[14] Department for Transport (2017). Air navigation guidance on airspace and noise management and environmental objectives. [online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/587669/air-navigation-guidance-on-airspace-and-noise-management-and-environmental-objectives.pdf [Checked 16/08/2021].
[15] British Standards Institution (2014). BS 8233:2014 Sound insulation and noise reduction for buildings – Code of practice. [Online]. Available at: https://shop.bsigroup.com/ProductDetail/?pid=000000000030241579&_ga=2.85437209.1462736480.1535108011-979344642.1535108011 [Checked: 16/08/2021].

Department of Education - Acoustic design of schools: performance standards BB93 (2015)

13A.4.28 The Department of Education's BB93[16] gives upper limits for indoor ambient noise level in terms of $L_{Aeq,30min}$ for new and refurbished schools, and schools formed by a material change of use, are as follows:

- Classroom and general teaching area - 35 dB $L_{Aeq,30min}$; and
- Teaching space (special communication needs) - 30 dB $L_{Aeq,30min}$.

13A.4.29 For classrooms and teaching spaces with natural ventilation, these levels can be achieved if the external noise level does not exceed 55 dB $L_{Aeq,30min}$.

13A.4.30 These standards, while not required by legislation to be achieved within those existing schools built prior to their introduction, provide a guide to determine potential impacts on existing schools.

Department of Health - Specialist Services, Health Technical Memorandum 08-01: Acoustics (2013)

13A.4.31 Guidance on recommended internal noise levels for healthcare facilities is given in the Department of Health's HTM 08-01[17]. This recommends internal noise levels for healthcare facilities as follows:

- Hospital wards, daytime - 40 dB $L_{Aeq,1h}$;
- Hospital wards, night - 35 dB $L_{Aeq,1h}$;
- Hospital wards, night - 45 dB $L_{Amax,F}$;
- Operating theatres, night - 40 dB $L_{Aeq,1h}$; and
- Operating theatres, night - 50 dB $L_{Amax,F}$.

13A.4.32 The L_{Amax} limit is applicable to events that occur several times during the night (for example passing trains) rather than sporadic events.

13A.4.33 These criteria would be relaxed for emergency situations and sporadic events subject to agreement by the local authority or other relevant body.

13A.4.34 For hospital wards with natural ventilation, these levels can be achieved if the external noise level does not exceed 55 dB $L_{Aeq,1h}$ and 50 dB $L_{Aeq,1h}$ during the day and night respectively.

CAP1616a Airspace Change: Environmental requirements technical annex

13A.4.35 This guidance document[18] produced in 2017 by the Civil Aviation Authority for airspace change sponsors providing guidance on the seven-stage airspace change process used for permanent changes to the published airspace design. The document guides the user through each stage and describes what will happen at each stage of it, and why.

13A.4.36 CAP 1616a forms a technical annex to this document and gives an outline of relevant methodologies for use in environmental assessment.

[16] Department of Education (2015). Acoustic design of schools: performance standards Building bulletin 93, [Online]. Available at: https://www.gov.uk/government/publications/bb93-acoustic-design-of-schools-performance-standards [Checked 16/08/2021]

[17] Department of Health (2013). Specialist Services, Health Technical Memorandum 08-01: Acoustics, [online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/144248/HTM_08-01.pdf [Checked 16/08/2021].

[18] Civil Aviation Authority (2017). CAP1616: Airspace Design: Guidance on the regulatory process for changing airspace design including community engagement requirements, [online]. Available at: https://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=8127 [Checked 16/08/2021].

BS7445 Description and measurement of environmental noise

13A.4.37 The aim of this British Standard is to provide authorities with material for the description of noise in community environments. The first part of the standard defines the basic quantities to be used and describes basic procedures for the determination of these quantities. The second part concerns the acquisition of data pertinent to land use, and the third part is a guide to application to noise limits.

13A.5 Noise Metrics for Assessment of Impacts of Air Noise

13A.5.1 In the UK, the Independent Commission on Civil Aviation Noise (ICCAN) is a body created to act as an independent, impartial voice on civil aviation noise and how it affects communities. They have recently undertaken a review of aviation noise metrics[19].

13A.5.2 The review notes that metrics aim to quantify noise in a meaningful way and that in terms of trying to determine the effect caused by noise there are two ways to look at noise measurements, the absolute value and the relative change. *"Absolute levels are important from a regulatory point of view, whereas the relative change in noise might be more informative for assessing annoyance, because of the way the human ear perceives sound."*

13A.5.3 The background section reports that *"since the early 1970s, research found that the L_{Aeq} metric was most closely associated with subjective response. The $L_{Aeq,T}$ is a notional continuous A-weighted sound level over a given time period, T, that contains the same sound energy as the actual time varying signal over the same time period"*. Both L_{den} and L_{night} are L_{Aeq} based metrics in addition to others such as $L_{Aeq,16h}$ and $L_{Aeq,8h}$.

13A.5.4 "Most of these metrics are well-established within the aviation sector, with an extensive existing knowledge base. This makes them useful for research into annoyance, as well as other health and social issues (WHO, Environmental Noise Guidelines for the European Region, 2018)."

13A.5.5 The review classifies these metrics as giving averaged results as they relate to a period of time during which a number of events may occur and return a value based on the noise across the period. In the case of L_{den} the metric also includes weighting with noise during the evening and at night treated as more significant when the overall level is determined. Table 1 of the review summarises some of the exposure noise metrics. The entries for metrics used in this assessment are included in Table 13A-4.

Table 13A-4: Exposure noise metrics based on L_{Aeq}

Metric	What it is	What if does	Weighting	Presence in UK Legislation, Policy and Standards	Links to effects on annoyance and other health issues
$L_{Aeq,T}$	The L_{eq} with the A indicating that the frequencies in the sound have been adjusted using the A weighting curve.	Provides an average value of the A weighted sound energy contained in the sound measured over a period, T.	Yes. The frequencies in the sound have been weighted using the A weighting curve.	Appears in various legislation, policy and standards associated with different time periods (T).	Generally felt to be a good indicator of likely annoyance and other health effects. Values can be influenced by a few very noisy events which could give a similar score to a large number of quieter events.
$L_{Aeq,16h}$	The $L_{Aeq,T}$ averaged over a 16 hour period. Conventionally that time period is 07:00 hours to 23:00 hours local time.	When determined for an average summer's day between the 16 June and 15 September, it is the main measure of aircraft noise impact	Yes. The frequencies in the sound have been weighted using the A weighting curve.	Appears in British Standards, such as BS 8233:2014. The summer average day value appears in Government policy on aviation noise management. This metric has been used by the UK for	An Exposure Response Function (ERF) exists between this metric and annoyance. This is thought to have changed over time. Also, some ERFs exist for other health effects.

[19] ICCAN A review of aviation noise metrics and measurement July 2020 https://iccan.gov.uk/wp-content/uploads/2020_07_16_ICCAN_review_of_aviation_noise_metrics_and_measurement.pdf [Checked 16/08/2021]

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

13A.5.6 The report also considers a different class of metrics, those related to single events. These describe the noise impact of a single aircraft movement or over-flight in terms of its intrusiveness, loudness, or noisiness. These can be simpler to present and understand but are not suitable for assessing the overall effects from multiple movements. Table 3 of the review summarises some of the single event metrics. The entries for metrics used in this assessment are included in Table 13A-5.

Table 13A-5: Single event noise metrics

Metric	What it is	What if does	Weighting	Presence in UK Legislation, Policy and Standards	Links to effects on annoyance and other health issues
L_{Amax}	The maximum A-weighted sound level of an aircraft event. It is derived from the root mean square of the varying sound pressure. To be meaningful, a response time has to be defined.	Gives the value of the maximum sound level from an event.	Yes. The various frequencies in the sound have been weighted using the A weighting curve.	Does not appear on its own as it requires information about the response time to be meaningful.	Frequently used in noise disturbance research. Some correlation found with sleep disturbance and speech interference. Strength of correlation unclear. Can be modified to the maximum noise experienced in the bedroom ($L_{Amax,inside}$) (CAA, 2009).
$L_{Amax,S}$	The L_{Amax} measured with a slow response time.	Gives the value of the maximum sound level from an event.	Yes. The various frequencies in the sound have been weighted using the A weighting curve.	Is used to define the maximum level from aircraft noise events.	Research tends not to differentiate between fast or slow response times
Nx	The number of events (flyovers or movements) that cause the maximum noise to be X dB or higher. It needs to have a time period associated with it, but at present does not regularly have that in the way it is described.	Provides an indication of the number of events likely to cause disturbance. The extent of the impact depends on the value chosen for X.	Yes, insofar as X is usually defined as the $L_{Amax,S}$.	Does not appear on its own as it requires information about the time period over which the value applies to be meaningful.	Depending on the value of X, there is some implied relationship with annoyance.
N65	This is Nx with X = 65 dB(A)	Provides an indication of the number of events likely to cause disturbance.	Yes, insofar as the 65 dB is expressed in terms of the $L_{Amax,S}$.	None	Some limited evidence linking to annoyance
N60	This is Nx with X = 60 dB(A)		Yes, insofar as the 65 dB is expressed in terms of the $L_{Amax,S}$.	None	Assuming 15 dB(A) sound reduction through a partially open window, it can be related to advice in the WHO Community Noise Guidelines (1999/2000).

13A.6 Derivation of Effect Scales Used

Air Noise – Residential Receptors

13A.6.1 Regulation (EU) No 598/2014 under Annex I requires that air traffic noise impact will be described, at least, in terms of noise indicators L_{den} and L_{night} which are defined and calculated in accordance with Annex I to Directive 2002/49/EC.

13A.6.2 The consideration of effects has involved the determination of the number of people 'highly sleep disturbed' and 'highly annoyed'. The latter has been done in accordance with the approach recommended by the World Health Organisation Environmental Guidelines 2018 (WHO 2018) as endorsed by the European Commission through Directive 2020/367, and has taken into account the noise exposure from 45 dB L_{den} and 40 dB L_{night} as appropriate. It is aircraft noise above these levels that WHO 2018 states are associated with adverse health effects.

13A.6.3 In addition to considering the overall effect, consideration has also been given to the significance of the change under the various options considered from the baseline. This considers both the resulting noise levels and the changes in noise levels. A consequence of this approach is that it puts emphasis on those newly affected, as they will experience the greatest changes, when considering the overall number significantly adversely affected.

13A.6.4 The classification and significance of effects is evaluated with reference to definitive standards, accepted criteria and legislation where available. This is supplemented by professional opinion and professional judgement.

13A.6.5 For the L_{den} and L_{night} noise indicators the significance of effect has been determined by separately rating both the absolute noise levels and the change in noise level as set out below. The individual ratings are then combined to determine the significance of any effects.

13A.6.6 The absolute noise values and associated impact criteria for residential receptors that have been developed are given in Table 13A-6. They commence with a negligible band which applies to noise levels that lie below a low threshold, specifically 45 dB L_{den} and 40 dB L_{night}, as WHO 2018 states that aircraft noise above these levels is associated with adverse health effects. The subsequent bands are defined by values that are required to be reported under Directive 2002/49/EC.

Table 13A-6: Noise Impact Criteria (absolute) – residential

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

13A.6.7 Taking L_{den}, the value of 55 dB is where WHO 2018 reports evidence of an effect on reading skills and oral comprehension in children. This value is also comparable to the level of 54 dB $L_{Aeq,16h}$ which is now used in the UK as marking the approximate onset of significant community annoyance. The value of 55 dB L_{den} has therefore been assigned to medium impact, as it relates to the start of these effects.

13A.6.8 Taking the value of 65 dB L_{den}, this is where WHO 2018 reports an association between those exposed and those considering themselves highly annoyed of 45.5%. Such a noise level is also comparable with the level of 63 dB $L_{Aeq,16h}$ widely used in the UK for eligibility for acoustic insulation, following Government guidance, and is also used for eligibility at Dublin under the North Runway Permission. The value of 65 dB L_{den} has therefore been assigned to the start of a high impact.

13A.6.9 For the night period the value of 45 dB L_{night} has been assigned to low impact. This follows from the approach in the UK where the Government proposed the value as the Lowest Observed Adverse Effect Level, and this received broad support.

13A.6.10 The level of 50 dB L_{night} is described as the desirable level in the Noise Action Plan for Dublin Airport 2019 – 2023[20]. This value has therefore been assigned to the level above which medium impact arises.

13A.6.11 The higher level of 55 dB L_{night} has been assigned to the level above which high impact arises. This follows from the WHO Night Noise Guidelines 2009 (NNG 2009)[6] which describe it as the threshold at which "Adverse health effects occur frequently, a sizeable proportion of the population is highly annoyed and sleep-disturbed". The noise level is also comparable with the level of 55 dB $L_{Aeq,8h}$ commonly used at airports in the UK for eligibility for sound insulation schemes.

[20] Fingal County Council Noise Action Plan for Dublin Airport 2019 - 2023 - December 2018
https://www.fingal.ie/sites/default/files/2019-04/NAP%20Final.pdf [Checked 16/08/2021]

13A.6.12 The scale to be used to assess the change in noise level is given in Table 13A-7. The thresholds are derived from the difference contour bands recommended in CAP1616a. A semantic scale of this type, following the format of examples given in the Institute of Environmental Management and Assessment guidelines, has been applied in previous air noise assessments and accepted in Public Inquiries for airport developments in the UK and Ireland, for example the application for the North Runway at Dublin Airport. The same approach was followed in the Heathrow 3rd Runway Preliminary Environmental Impact Report (PEIR).

Table 13A-7: Noise Impact Criteria (relative)

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

13A.6.13 The effect of a change in noise level tends to increase with the absolute level of noise experienced at a receptor. If, for example, the night-time noise level at a dwelling were to change from 45 dB to 50 dB L_{night}, the overall effect for the occupants would be less than if the night-time noise level were to increase by the same amount from 55 dB to 60 dB L_{night}.

13A.6.14 The EPA Draft Guidelines advises that adherence to a systematic method of description can be of considerable assistance and includes in a Table 3.3 relevant terms that can be used to consistently describe specific effects. In terms of describing the significance of effects the terms range from imperceptible to profound, and they have been used here.

13A.6.15 There is no clearly accepted method of how to rate the magnitude of the effect of a change in the absolute air noise level and the associated change in noise level. Some guidance however has been provided in the UK's National Planning Practice Guidance (NPPG) which states:

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

13A.6.16 The magnitude of an effect from changing between one scenario and another (e.g. baseline to future with the Relevant Action) has been established by considering both the absolute noise level in the higher of the two scenarios and the relative change in noise level that occurs at a given receptor.

13A.6.17 Table 13A-8 shows how the absolute and relative impacts are interpreted into magnitude of effect. This considers the criteria presented above, other guidance and professional judgement. The effect rating scale is taken from the EPA Draft EIAR Guidelines.

Table 13A-8: Summary of magnitude of effect – noise

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

13A.6.18 A potential significant effect (adverse or beneficial) would be considered to arise if in Table 13A-8 the magnitude of the effect was rated as significant or higher.

Air Noise – Non-Residential Receptors

13A.6.19 For non-residential receptors a similar, although simplified, approach has been used. Absolute levels rated as medium have been derived from the relevant guidance documents. These are given in Table 13-9. The impact on each non-residential receptor has been rated as significant if the absolute noise level is above this threshold and the change in noise level is at least 3 dB(A), i.e. it is rated medium or higher.

13A.6.20 For schools the medium threshold has been based on the guidance in Building Bulletin 93, specifically that the internal noise levels for classrooms and teaching spaces that it contains can be achieved with natural ventilation if the external noise level does not exceed 55 dB $L_{Aeq,30min}$. Reviewing the distribution of flights at Dublin Airport it has been estimated that this criterion corresponds to approximately 55 dB L_{den}, which is the level where WHO 2018 reports evidence of an effect on reading skills and oral comprehension in children.

13A.6.21 For residential healthcare facilities, the medium thresholds have based on the guidance in Health Technical Memorandum 08-01, specifically that the internal noise levels for hospital wards that it contains can be achieved with natural ventilation if the external noise level does not exceed 55 dB $L_{Aeq,1h}$ and 50 dB $L_{Aeq,1h}$ during the day and night respectively. Reviewing the distribution of flights at Dublin Airport it has been estimated that these criteria correspond to approximately 55 dB L_{den} and 45 dB L_{night} respectively.

13A.6.22 For places of worship the medium threshold is the same as that for residential dwelling has on the basis that the British Standard BS8233:2014 recommends comparable internal noise levels for both types of spaces.

13A.6.23 The resulting air noise impact criteria for non-residential properties are given in Table 13-9.

Table 13-9: Air Noise Impact Criteria (absolute) – non-residential

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

Appendix 13B. Air Noise Methodology

Document Classification: Class 1 - General

13B. Air noise modelling methodology

13B.1 Introduction

13B.1.1 This appendix of the Environmental Impact Assessment Report (EIAR), prepared by Bickerdike Allen Partners LLP, describes the modelling methodology for the air noise predictions.

- Section 13B.2 details the scenarios that have been assessed and presents summaries of the aircraft movements.
- Section 13B.3 sets out the methodology and the assumptions used in the prediction of airborne aircraft noise levels and the production of noise contours.
- Section 13B.4 sets out the methodology used to assess the number of people and dwellings within the contours, as well as noise sensitive community buildings such as schools and hospitals.

13B.2 Assessment Scenarios

Scenarios to be Assessed

13B.2.1 Seven scenarios have been included in the air noise assessment; these are:

- 2018
- 2022 Permitted
- 2022 Proposed
- 2025 Permitted
- 2025 Proposed
- 2035 Permitted
- 2035 Proposed

13B.2.2 The 2018 scenario is based on the actual aircraft movements that occurred during 2018 which have been supplied by the Applicant. The future assessments are based on air traffic movement forecasts which have been supplied by Mott Macdonald.

13B.2.3 The annual day, evening and night movements, and the summer day and night movements are given in the tables below by aircraft type for each of the scenarios. Aircraft types with a small number of movements have been grouped under “Other”.

Table 13B-1: 2018 Actual Movements

Aircraft Type	2018 Actual Movements				
	Annual			92-Day Summer	
	Day 07h-19h	Evening 19h-23h	Night 23h-07h	Day 07h-23h	Night 23h-07h
Airbus A306	214	337	487	130	127
Airbus A319	2,991	924	160	1,061	12
Airbus A320	41,542	10,156	6,015	14,270	2,293
Airbus A320neo	30	4	8	0	0
Airbus A321	5,596	537	948	2,023	377
Airbus A321neo	0	0	0	0	0
Airbus A330	9,519	396	2,059	3,098	584
Airbus A330neo	0	0	0	0	0
Airbus A350	135	2	105	60	45
ATR 42	2,327	272	1	672	1
ATR 72	14,142	2,432	1,098	4,626	322
BAe 146/Avro RJ	4,314	963	354	1,472	126
Boeing 737-400	254	567	611	268	151
Boeing 737-700	1,420	289	286	468	63
Boeing 737-800	55,616	17,096	10,838	19,517	3,250
Boeing 737 MAX	1,625	77	392	508	140
Boeing 757	2,702	35	879	1,084	236
Boeing 767	1,088	472	491	457	137
Boeing 777	1,508	591	973	570	285
Boeing 777X	0	0	0	0	0
Boeing 787	1,554	160	898	597	194
Bombardier CS300	484	2	0	144	0
Bombardier Dash 8	2,858	1,321	15	1,147	3
Embraer E190/195	4,737	1,669	182	1,534	95
Embraer E190-E2	6	0	0	0	0
Other	9,417	2,061	1,096	3,408	314
Total	**164,079**	**40,363**	**27,896**	**57,114**	**8,755**

Table 13B-2: 2022 Permitted Scenario Forecast Movements

Aircraft Type	2022 Permitted Scenario Forecast Movements				
	Annual			92-Day Summer	
	Day 07h-19h	Evening 19h-23h	Night 23h-07h	Day 07h-23h	Night 23h-07h
Airbus A306	0	300	0	90	0
Airbus A319	1,502	300	0	541	0
Airbus A320	25,537	6,910	4,507	9,737	1,352
Airbus A320neo	1,502	901	0	721	0
Airbus A321	4,807	0	601	1,443	180
Airbus A321neo	1,502	300	601	541	180
Airbus A330	9,314	0	300	2,795	90
Airbus A330neo	0	0	0	0	0
Airbus A350	0	0	0	0	0
ATR 42	0	0	0	0	0
ATR 72	14,721	2,103	601	5,049	180
BAe 146/Avro RJ	0	0	0	0	0
Boeing 737-400	0	601	1,202	180	361
Boeing 737-700	0	0	0	0	0
Boeing 737-800	38,456	17,125	5,107	16,680	1,533
Boeing 737 MAX	2,403	1,202	0	1,082	0
Boeing 757	0	0	0	0	0
Boeing 767	300	601	901	270	270
Boeing 777	300	601	300	270	90
Boeing 777X	0	0	0	0	0
Boeing 787	4,206	0	601	1,262	180
Bombardier CS300	1,202	0	0	361	0
Bombardier Dash 8	1,202	601	0	541	0
Embraer E190/195	5,107	2,103	601	2,164	180
Embraer E190-E2	0	0	0	0	0
Other	3,605	1,202	0	1,443	0
Total	**115,668**	**34,851**	**15,322**	**45,170**	**4,598**

Table 13B-3: 2022 Proposed Scenario Forecast Movements

Aircraft Type	2022 Proposed Scenario Forecast Movements				
	Annual			92-Day Summer	
	Day 07h-19h	Evening 19h-23h	Night 23h-07h	Day 07h-23h	Night 23h-07h
Airbus A306	0	300	0	90	0
Airbus A319	1,502	300	0	541	0
Airbus A320	27,036	6,609	6,609	10,098	1,984
Airbus A320neo	1,502	901	0	721	0
Airbus A321	5,107	300	1,202	1,623	361
Airbus A321neo	1,202	300	901	451	270
Airbus A330	8,111	0	1,502	2,434	451
Airbus A330neo	0	0	0	0	0
Airbus A350	0	0	0	0	0
ATR 42	0	0	0	0	0
ATR 72	14,119	2,103	1,202	4,869	361
BAe 146/Avro RJ	0	0	0	0	0
Boeing 737-400	0	601	1,202	180	361
Boeing 737-700	0	0	0	0	0
Boeing 737-800	41,155	15,921	9,012	17,130	2,705
Boeing 737 MAX	2,403	1,202	0	1,082	0
Boeing 757	0	0	0	0	0
Boeing 767	300	601	901	270	270
Boeing 777	0	601	601	180	180
Boeing 777X	0	0	0	0	0
Boeing 787	3,905	0	901	1,172	270
Bombardier CS300	1,202	0	0	361	0
Bombardier Dash 8	1,202	601	0	541	0
Embraer E190/195	4,806	2,403	601	2,164	180
Embraer E190-E2	0	0	0	0	0
Other	3,605	1,202	0	1,443	0
Total	**117,158**	**33,946**	**24,633**	**45,350**	**7,393**

Table 13B-4: 2025 Permitted Scenario Forecast Movements

Aircraft Type	2025 Permitted Scenario Forecast Movements				
	Annual			92-Day Summer	
	Day 07h-19h	Evening 19h-23h	Night 23h-07h	Day 07h-23h	Night 23h-07h
Airbus A306	0	0	0	0	0
Airbus A319	651	0	0	180	0
Airbus A320	34,162	8,134	5,206	11,721	1,443
Airbus A320neo	11,387	3,254	976	4,057	270
Airbus A321	651	0	0	180	0
Airbus A321neo	5,531	325	1,301	1,623	361
Airbus A330	11,062	325	651	3,156	180
Airbus A330neo	2,603	0	0	721	0
Airbus A350	651	0	0	180	0
ATR 42	0	0	0	0	0
ATR 72	15,942	2,277	651	5,049	180
BAe 146/Avro RJ	0	0	0	0	0
Boeing 737-400	0	0	651	0	180
Boeing 737-700	325	325	0	180	0
Boeing 737-800	46,200	18,545	7,483	17,942	2,074
Boeing 737 MAX	10,737	4,880	0	4,328	0
Boeing 757	0	0	0	0	0
Boeing 767	325	651	976	270	270
Boeing 777	325	0	325	90	90
Boeing 777X	651	651	0	361	0
Boeing 787	6,507	0	651	1,803	180
Bombardier CS300	1,301	0	0	361	0
Bombardier Dash 8	2,603	651	0	902	0
Embraer E190/195	6,832	2,277	651	2,524	180
Embraer E190-E2	0	0	0	0	0
Other	5,206	1,301	0	1,803	0
Total	**163,653**	**43,598**	**19,521**	**57,432**	**5,410**

Table 13B-5: 2025 Proposed Scenario Forecast Movements

Aircraft Type	2025 Proposed Scenario Forecast Movements				
	Annual			92-Day Summer	
	Day 07h-19h	Evening 19h-23h	Night 23h-07h	Day 07h-23h	Night 23h-07h
Airbus A306	0	0	0	0	0
Airbus A319	651	0	0	180	0
Airbus A320	34,488	7,809	7,809	11,721	2,164
Airbus A320neo	11,062	3,254	1,301	3,967	361
Airbus A321	651	0	0	180	0
Airbus A321neo	5,531	651	2,277	1,713	631
Airbus A330	10,086	325	1,627	2,885	451
Airbus A330neo	2,277	0	325	631	90
Airbus A350	325	0	325	90	90
ATR 42	0	0	0	0	0
ATR 72	15,292	2,277	1,301	4,869	361
BAe 146/Avro RJ	0	0	0	0	0
Boeing 737-400	0	0	651	0	180
Boeing 737-700	325	325	0	180	0
Boeing 737-800	49,454	16,268	13,014	18,212	3,606
Boeing 737 MAX	10,086	4,230	0	3,967	0
Boeing 757	0	0	0	0	0
Boeing 767	325	651	976	270	270
Boeing 777	0	0	651	0	180
Boeing 777X	651	651	0	361	0
Boeing 787	6,182	0	976	1,713	270
Bombardier CS300	1,301	0	0	361	0
Bombardier Dash 8	2,603	651	0	902	0
Embraer E190/195	6,507	2,603	651	2,524	180
Embraer E190-E2	0	0	0	0	0
Other	5,206	1,301	0	1,803	0
Total	**163,003**	**40,995**	**31,885**	**56,530**	**8,836**

Table 13B-6: 2035 Permitted Scenario Forecast Movements

Aircraft Type	2035 Permitted Scenario Forecast Movements				
	Annual			92-Day Summer	
	Day 07h-19h	Evening 19h-23h	Night 23h-07h	Day 07h-23h	Night 23h-07h
Airbus A306	0	0	0	0	0
Airbus A319	651	0	0	180	0
Airbus A320	17,895	4,555	2,277	6,221	631
Airbus A320neo	29,933	7,809	3,904	10,459	1,082
Airbus A321	651	0	0	180	0
Airbus A321neo	8,459	651	1,301	2,524	361
Airbus A330	6,182	325	325	1,803	90
Airbus A330neo	6,182	0	325	1,713	90
Airbus A350	651	0	0	180	0
ATR 42	0	0	0	0	0
ATR 72	15,942	2,277	651	5,049	180
BAe 146/Avro RJ	0	0	0	0	0
Boeing 737-400	0	0	651	0	180
Boeing 737-700	0	0	0	0	0
Boeing 737-800	5,531	4,880	1,301	2,885	361
Boeing 737 MAX	54,660	18,545	6,182	20,286	1,713
Boeing 757	0	0	0	0	0
Boeing 767	325	651	976	270	270
Boeing 777	325	0	325	90	90
Boeing 777X	651	651	0	361	0
Boeing 787	7,809	0	651	2,164	180
Bombardier CS300	1,952	0	0	541	0
Bombardier Dash 8	2,603	651	0	902	0
Embraer E190/195	651	0	0	180	0
Embraer E190-E2	6,182	2,277	651	2,344	180
Other	4,555	1,301	0	1,623	0
Total	**171,787**	**44,574**	**19,521**	**59,956**	**5,410**

Table 13B-7: 2035 Proposed Scenario Forecast Movements

Aircraft Type	2035 Proposed Scenario Forecast Movements				
	Annual			92-Day Summer	
	Day 07h-19h	Evening 19h-23h	Night 23h-07h	Day 07h-23h	Night 23h-07h
Airbus A306	0	0	0	0	0
Airbus A319	651	0	0	180	0
Airbus A320	16,593	4,230	3,904	5,770	1,082
Airbus A320neo	29,607	6,832	5,206	10,098	1,443
Airbus A321	651	0	0	180	0
Airbus A321neo	5,531	651	2,277	1,713	631
Airbus A330	5,206	325	1,301	1,533	361
Airbus A330neo	5,856	0	651	1,623	180
Airbus A350	325	0	325	90	90
ATR 42	0	0	0	0	0
ATR 72	15,292	2,277	1,301	4,869	361
BAe 146/Avro RJ	0	0	0	0	0
Boeing 737-400	0	0	651	0	180
Boeing 737-700	0	0	0	0	0
Boeing 737-800	5,531	4,230	1,301	2,705	361
Boeing 737 MAX	54,334	16,593	11,713	19,655	3,246
Boeing 757	0	0	0	0	0
Boeing 767	325	651	976	270	270
Boeing 777	0	0	651	0	180
Boeing 777X	651	651	0	361	0
Boeing 787	7,483	0	976	2,074	270
Bombardier CS300	1,301	0	0	361	0
Bombardier Dash 8	2,603	651	0	902	0
Embraer E190/195	651	0	0	180	0
Embraer E190-E2	5,856	2,603	651	2,344	180
Other	4,555	1,301	0	1,623	0
Total	**163,003**	**40,995**	**31,885**	**56,530**	**8,836**

13B.3 Noise Modelling Methodology

Software

13B.3.1 The noise modelling utilises the Federal Aviation Authority Aviation Environmental Design Tool (AEDT) version 2d SP2, which is compliant with *ECAC.CEAC Doc 29 4th Edition Report on Standard Method of Computing Noise Contours around Civil Airports* and with *EU Commission Directive 2015/996 Establishing common noise assessment methods according to Directive 2002/49/EC of the European Parliament and of the Council*. This was the latest version of the software when the assessment work began.

13B.3.2 The AEDT software evaluates aircraft noise in the vicinity of airports using flight track information, aircraft fleet mix, aircraft profiles and terrain. The AEDT software is used to produce noise exposure contours as well as predict noise levels at specific user-defined sites. For Dublin Airport the input data has comprised:

- physical details of the airport, both current and future,
- the topography of the surrounding area,
- the aircraft movements themselves,
- the routes flown by the aircraft movements,
- the procedures used by the aircraft movements,
- dwelling, population and community building data.

Study Area

13B.3.3 The study area is based on the largest extent of likely impacts due to air noise, i.e. encompassing an envelope formed by the lowest value noise contours assessed for each metric. The extents of the study area are contained within a rectangle that extends 25 km to the west, 30 km to the east, 20 km to the north and 25 km to the south of the centre of the South Runway at Dublin Airport. Figure 13B-1 shows the study area.

AEDT Study

13B.3.4 The AEDT default weather settings for Dublin Airport and all-soft ground lateral attenuation have been used. The directivity effects of aircraft bank angle have been allowed for in accordance with EU Directive 2015/996.

13B.3.5 Terrain data has been acquired for the study area. This was provided by emapsite in the form of a Digital Terrain Model dataset and has been incorporated within the noise model.

Airport Layout

13B.3.6 The airfield layout including runways and taxiways is shown on the AIP Ireland Aerodrome Chart[1]. This information has been used with a construction drawing for the North Runway supplied by daa to locate the Dublin Airport runways in the model.

Aircraft Movements

13B.3.7 The AEDT software includes noise information for many common aircraft types, but it does not include every aircraft type. Therefore, the actual and forecast aircraft types need to be mapped to aircraft types in the AEDT software. For most aircraft, substitutions are proposed by the AEDT software or the ANP database[2] where a similar alternative aircraft type is used to model the actual type. For larger aircraft this generally does not involve a change but for the smaller aircraft, and in particular the general aviation aircraft, some substitutions occur. Where the AEDT and ANP databases have no guidance, an aircraft type has been assigned based on the aircraft size and engine details.

13B.3.8 This is in accordance with EU Directive 2015/996 which states that "The ANP database provided in Appendix I covers most existing aircraft types. For aircraft types or variants for which data are not currently listed, they can best be represented by data for other, normally similar, aircraft that are listed."

13B.3.9 Helicopters and military aircraft have been excluded from this assessment as they perform less than 1% of the aircraft movements at Dublin Airport and therefore do not materially contribute to the noise contours. They have historically been excluded from aircraft noise contours produced for Dublin Airport.

13B.3.10 This is in accordance with EU Directive 2015/996 which states "Where noise generating activities associated with airport operations do not contribute materially to the overall population exposure to aircraft noise and associated noise contours, they may be excluded. These activities include: helicopters, taxiing, engine testing and use of auxiliary power-units."

[1] EIDW AD 2.24-1, dated 28 March 2019, http://iaip.iaa.ie/iaip/IAIP_Frame_CD.htm
[2] Aircraft Noise and Performance Database, https://www.aircraftnoisemodel.org

Runway Usage

Current Situation

13B.3.11 For 2018 the runway used by each individual aircraft movement has been put into the model. A summary of the overall runway split for the 2018 annual period is given in Table 13B-8.

Table 13B-8: 2018 Annual Runway Usage

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

North Runway Airport Layout

13B.3.12 Once the North Runway is operational the Crosswind Runway (16/34) will continue to be used, however only for essential use (e.g. when there are strong crosswinds) as stated in Condition 4 of the North Runway Permission. The past use of the crosswind runway has been reviewed and is reported in *Crosswind Runway Information, Requested by ANCA RFI Appendix A, Request H and Table 4 Items 79, 80 and 81, Ricondo, May* 2021. Allowing for this, for the purposes of noise modelling the future usage of the Crosswind Runway is assumed to be 1% of aircraft movements, with the remaining 99% of movements on the two main runways. 0.75% of aircraft movements are forecast to use Runway 16 with the remaining 0.25% on Runway 34. The modelled future runway usage over a given year is summarised in Table 13B-9 below, based on the average runway usage over the last 10 years and allowing for the expected reduction in Crosswind Runway usage.

Table 13B-9: Future Runway Usage

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

13B.3.13 Once the North Runway is operational Dublin Airport will operate during the daytime (07:00 – 23:00) in accordance with Conditions 3a-3c per the mode of operation Option 7b, as detailed in the Environmental Impact Statement Addendum, Section 16 as received by the planning authority on the 9th day of August, 2005. This provides that:

a. “the parallel runways (10R-28L and 10L-28R) shall be used in preference to the Crosswind 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.”

13B.3.14 In practice it is expected that, unless capacity requires mixed mode, the runways will operate in segregated mode during the daytime with arrivals using either Runway 10L or Runway 28L and departures using either Runway 10R or Runway 28R depending on wind direction.

13B.3.15 Any movements by Code F aircraft are an exception to this, as they will always use the North Runway. It is also understood that departures by Category A & B aircraft heading south during westerly operations will use the South Runway, and those heading north during easterly operations will use the North Runway.

13B.3.16 A method of determining mixed mode runway usage on the main runways (North and South) for modelling purposes has been developed. The modelled runway usage has been determined on an hourly basis.

13B.3.17 Most of the time the runways will operate in segregated mode, i.e. one runway for all arrivals, the other for all departures. However, there will be occasions during peak hours when runways will need to operate in some degree of mixed mode, i.e. both runways used simultaneously for arrivals and/or departures. The change from segregated to mixed mode and back to segregated mode will be determined by air traffic control (ATC) and once changed to a particular mode the airport is likely to operate in that mode for at least two hours.

13B.3.18 The method assumes activity switches from segregated mode to mixed mode where activity is such that any of the three following single runway capacity limits are exceeded:

i. More than 35 arrivals in one hour.

ii. More than 44 departures in one hour.

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

13B.3.19 The exception to this is for the Proposed Scenario in the Assessment Years of 2025 and 2035, where mixed mode has been assumed to be in operation between 06:00 and 07:59. This is based on advice from the IAA that they would require both runways to be available during this peak period once the Crosswind Runway was no longer available.

13B.3.20 In mixed mode, where each individual runway handles both arrivals and departures, departures will operate using the compass departure principle. This means that if a departure is using a route that turns to the north then the North Runway will be used, and conversely if it is using a route that turns to the south, the South Runway will be used.

13B.3.21 For westerly operations when in mixed mode as few arrivals as possible will use 28R, while not exceeding the single runway capacity limit of 48 combined arrivals and departures on runway 28L. For easterly operations when in mixed mode as few arrivals as possible will use 10R, while not exceeding the single runway capacity limit of 48 combined arrivals and departures on runway 10L.

13B.3.22 When using the North Runway most aircraft will not use the full length on departure, and instead join the runway from the 1st intermediate taxiway. The exceptions are Code E and any Code F aircraft, which will typically use the full runway length. All departures on the South Runway are assumed to use the full runway length.

13B.3.23 During the night-time period (23:00 – 07:00) for the Permitted Scenarios the South Runway is the preferred runway. For the Proposed Scenarios the South Runway is the preferred runway in the core night period (00:00-06:00). Between 23:00 and 00:00 and between 06:00-07:00 the runway usage follows the same principles as in the daytime, i.e. Option 7b.

13B.3.24 The resulting runway usage by hour on an average annual day for both easterly and westerly operations is shown in Table 13B-10 and Table 13B-11 for the Permitted Scenarios, and in Table 13B-12 and Table 13B-13 for the Proposed Scenarios.

Table 13B-10: Average Annual Day Runway Usage By Hour – Westerly Operations, Permitted Scenarios

Hour	2022 Permitted		2025 Permitted		2035 Permitted	
	28L (South)	28R (North)	28L (South)	28R (North)	28L (South)	28R (North)
00:00-00:59	6	0	7	0	7	0
01:00-01:59	5	0	8	0	8	0
02:00-02:59	2	0	2	0	2	0
03:00-03:59	0	0	0	0	0	0
04:00-04:59	5	0	6	0	6	0
05:00-05:59	11	0	11	0	11	0
06:00-06:59	16	0	17	0	17	0
07:00-07:59	16	37	40	29	46	30
08:00-08:59	19	11	25	8	27	9
09:00-09:59	17	12	26	14	26	15
10:00-10:59	11	13	18	21	19	21
11:00-11:59	11	13	20	19	20	19
12:00-12:59	24	10	28	22	29	24
13:00-13:59	12	18	15	22	16	23
14:00-14:59	16	13	19	18	19	19
15:00-15:59	11	20	14	21	14	21
16:00-16:59	22	14	25	19	27	19
17:00-17:59	16	18	20	19	22	20
18:00-18:59	16	15	21	20	21	22
19:00-19:59	20	15	23	20	24	20
20:00-20:59	9	17	10	20	10	21
21:00-21:59	14	7	16	8	16	8
22:00-22:59	28	6	31	6	32	6
23:00-23:59	6	0	9	0	9	0

Note: All values rounded to nearest whole number

Table 13B-11: Average Annual Day Runway Usage By Hour – Easterly Operations, Permitted Scenarios

Hour	2022 Permitted		2025 Permitted		2035 Permitted	
	10R (South)	10L (North)	10R (South)	10L (North)	10R (South)	10L (North)
00:00-00:59	6	0	7	0	7	0
01:00-01:59	5	0	8	0	8	0
02:00-02:59	2	0	2	0	2	0
03:00-03:59	0	0	0	0	0	0
04:00-04:59	5	0	6	0	6	0
05:00-05:59	11	0	11	0	11	0
06:00-06:59	16	0	17	0	17	0
07:00-07:59	33	20	43	26	28	48
08:00-08:59	10	20	12	21	5	31
09:00-09:59	11	18	13	27	14	27
10:00-10:59	9	15	17	22	17	23
11:00-11:59	15	9	21	18	21	18
12:00-12:59	11	23	22	28	24	29
13:00-13:59	15	15	19	18	20	19
14:00-14:59	13	16	18	19	19	19
15:00-15:59	17	14	18	17	18	17
16:00-16:59	14	22	19	25	19	27
17:00-17:59	20	14	21	18	22	20
18:00-18:59	13	18	18	23	20	23
19:00-19:59	13	22	18	25	18	26
20:00-20:59	17	9	20	10	21	10
21:00-21:59	8	13	9	15	9	15
22:00-22:59	6	28	6	31	6	32
23:00-23:59	6	0	9	0	9	0

Note: All values rounded to nearest whole number

Table 13B-12: Average Annual Day Runway Usage By Hour – Westerly Operations, Proposed Scenarios

Hour	2022 Proposed		2025 Proposed		2035 Proposed	
	28L (South)	28R (North)	28L (South)	28R (North)	28L (South)	28R (North)
00:00-00:59	9	0	12	0	12	0
01:00-01:59	6	0	9	0	9	0
02:00-02:59	3	0	3	0	3	0
03:00-03:59	0	0	0	0	0	0
04:00-04:59	7	0	8	0	8	0
05:00-05:59	10	0	10	0	10	0
06:00-06:59	2	28	22	15	22	15
07:00-07:59	9	32	29	22	29	22
08:00-08:59	19	11	22	12	22	12
09:00-09:59	16	14	24	17	24	17
10:00-10:59	11	12	18	18	18	18
11:00-11:59	12	14	20	19	20	19
12:00-12:59	24	10	28	23	28	23
13:00-13:59	16	18	19	21	19	21
14:00-14:59	15	15	20	20	20	20
15:00-15:59	13	21	15	23	15	23
16:00-16:59	22	16	25	20	25	20
17:00-17:59	18	16	22	20	22	20
18:00-18:59	15	21	20	24	20	24
19:00-19:59	20	17	20	22	20	22
20:00-20:59	11	17	12	18	12	18
21:00-21:59	12	9	14	9	14	9
22:00-22:59	22	5	26	5	26	5
23:00-23:59	17	0	18	1	18	1

Note: All values rounded to nearest whole number

Table 13B-13: Average Annual Day Runway Usage By Hour – Easterly Operations, Proposed Scenarios

Hour	2022 Proposed		2025 Proposed		2035 Proposed	
	10R (South)	10L (North)	10R (South)	10L (North)	10R (South)	10L (North)
00:00-00:59	9	0	12	0	12	0
01:00-01:59	6	0	9	0	9	0
02:00-02:59	3	0	3	0	3	0
03:00-03:59	0	0	0	0	0	0
04:00-04:59	7	0	8	0	8	0
05:00-05:59	10	0	10	0	10	0
06:00-06:59	28	2	20	17	20	17
07:00-07:59	28	13	16	35	16	35
08:00-08:59	10	20	12	22	12	22
09:00-09:59	13	17	16	25	16	25
10:00-10:59	8	15	14	22	14	22
11:00-11:59	16	10	21	18	21	18
12:00-12:59	11	23	23	28	23	28
13:00-13:59	16	18	19	21	19	21
14:00-14:59	14	16	19	21	19	21
15:00-15:59	18	16	20	18	20	18
16:00-16:59	16	22	20	25	20	25
17:00-17:59	18	16	22	20	22	20
18:00-18:59	19	17	22	22	22	22
19:00-19:59	15	22	20	22	20	22
20:00-20:59	17	11	18	12	18	12
21:00-21:59	10	11	10	13	10	13
22:00-22:59	5	22	5	26	5	26
23:00-23:59	0	17	1	18	1	18

Note: All values rounded to nearest whole number

Flight Routes

13B.3.25 Flight routes refer to the ground tracks followed by aircraft. In practice every aircraft follows a slightly different route, depending on the weather conditions and aircraft characteristics. For modelling purposes, it is typically considered sufficient to model each distinct route using what is known as a backbone track, as well as a number of sub-tracks either side of the backbone tracks to represent the variation in actual routes flown.

13B.3.26 This approach is in accordance with EU Directive 2015/996 which states that “It is common practice to treat the data for a single route as a sample from a single population; i.e. to be represented by one backbone track and one set of dispersed subtracks.”

13B.3.27 This approach has the benefit of reducing the complexity of the noise model without significantly affecting its accuracy, as well as enabling the current and future operations to be modelled on the same basis.

Flight Routes – Current Situation

13B.3.28 For the Crosswind Runway straight arrival routes have been used with a set of modelled departure routes for Category A & B and Category C & D aircraft, which have been developed based on the published SIDs.

13B.3.29 For the South Runway, based on an analysis of radar data in 2018, approaching aircraft are generally lined up with the extended centreline of the runway at least 17 km from the runway threshold. Consequently, the South Runway approach 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. The modelled current arrival routes are shown in pink on Figure 13B-2.

13B.3.30 For departures on the South Runway, the current routes used vary with aircraft type and destination.

13B.3.31 Category A & B aircraft, which are predominantly turboprops such as the ATR 72, are not required by the IAA to remain within the existing environmental corridors to the same extent as the larger jet aircraft types. They therefore commonly turn off the extended runway centreline to the north or south shortly after the end of the runway. A review of radar tracks for recent activity has resulted in a set of routes for these aircraft types shown in red on Figure 13B-2.

13B.3.32 Currently the airport has a total of 11 Standard Instrument Departure (SID) routes for westerly operations and 10 for easterly operations, although in both cases a number are initially the same until after they have left the study area. Given this similarity, for noise modelling purposes a set of seven initial departure routes have been created from the western end and four initial departure routes from the eastern end. Table 13B-14 shows which route has been used to model each SID and gives the initial direction of the routes.

Table 13B-14: Departure Routes Used to Model SIDs

SID	Modelled Route		Initial Direction
	Westerly Operations	Easterly Operations	
BAMLI	ROTEV	ROTEV	North
BEPAN	NEPOD	NEPOD	South
DEXEN	DEXEN	DEXEN	East
INKUR	INKUR	ROTEV	West
LIFFY	LIFFY	LIFFY	East
OLONO	NEPOD	NEPOD	South
PELIG[1]	PELIG	-	West
PESIT	NEPOD	NEPOD	South
NEVRI	ROTEV	ROTEV	North
ROTEV	ROTEV	ROTEV	North
SUROX	SUROX	ROTEV	North

[1] Westerly Operations Only

13B.3.33 For Category C & D aircraft, which are jet engined aircraft, these routes have been supplemented for departures to the west by routes that turn earlier, although not as early as Category A & B aircraft routes. This assumption originally arose from a detailed review of 2010 radar data and has been confirmed as remaining appropriate by a review of recent radar data. These reviews found that many of the Category C & D on runway 28 actually performed their initial turn earlier than described by the SIDs. This is because after reaching an altitude of 3000 ft, they are vectored off by ATC. Two additional 'Early Turn' routes were therefore created for each route with initial turns to the north, south, or east, i.e. the ROTEV, NEPOD, LIFFY and DEXEN routes. Traffic has been distributed equally between the three turning points, i.e. the two early turns and the SID, for each route.

13B.3.34 The modelled current Category C & D routes are shown in blue on Figure 13B-2.

Flight Routes – North Runway Airport Layout

13B.3.35 Due to the expected reduction in the use of the Crosswind Runway in the future, the areas exposed to the minimum noise levels of interest do not reach the point where aircraft turn off the extended runway centreline. Straight arrival and departure routes have therefore been used for the Crosswind Runway in the interests of reducing the complexity of the model.

13B.3.36 Arrival routes for the South Runway have been modelled as for current operations. Arrival routes have been created for the North Runway which replicate those for the South Runway. The modelled arrival routes based on the future North Runway airport layout are shown on Figures 13B-3 and 13B-4.

13B.3.37 Once the North Runway is in use Category A & B aircraft will continue to turn off the extended runway centreline shortly after the end of the runway, however they will not be allowed to turn across the other runway, i.e. they cannot turn north off the South Runway and vice versa. A new set of departure routes has therefore been developed for Category A & B aircraft. From the South Runway this replicates the current routes, but with no turns to the north. For the North Runway the routes have been designed to replicate the current routes as closely as possible but with no turns to the south as shown in Figures 13B-3 and 13B-4.

13B.3.38 For Category C & D aircraft a number of the modelled routes have been used to represent more than one of the SIDs, so combining the traffic on some of the SIDs onto a single modelled route. The departure routes to the west are supplemented by early turn routes, similar to the current routes.

13B.3.39 In order to achieve a safe minimum separation between departures and arrivals performing a go around and based on public consultation and a subsequent detailed safety assessment by the Air Traffic Service Provider, a course divergence of at least 30° is required. As the runways are parallel this necessitated an early turn by departures from the North Runway.

13B.3.40 An analysis was undertaken to determine the best initial turn angles taking into account the resulting noise, and the local community was consulted on the options. The analysis concluded that that for departures to the west there were limited differences between the various turn angle options, but an initial turn or 15° or 30° to the north was favourable in terms of the overall numbers of sensitive receptors under the flight path. This was supplemented with a 75° initial turn for departures heading to the north or west off the North Runway in westerly departures. For departures to the east an initial turn of 15° to the north was the most favourable option. The public consultation resulted in the 15º/75º divergence to the west off North Runway and 15º to the east going forward for further analysis.

13B.3.41 The subsequent detailed airspace design indicated that a course divergence of at least 30º was required for westerly departures in order to allow for safety requirements associated with potential missed approaches or go arounds. The final set of divergence was therefore selected to be 30º and 75º to the west and 15º to the east.

13B.3.42 A set of departure routes from the North Runway was then developed that replicated the current routes as closely as possible, while allowing for these initial turns. The result is routes with an early turn to the north. When heading east all of the routes turn 15° at 1.06nm from the end of the runway. When heading to the west the routes to DEXEN, INKUR, NEPOD, PELIG and SUROX turn 30°, while those to ABBEY and ROTEV turn 75°, all at 1.18nm from the end of the runway.

13B.3.43 The departures on the South Runway continue along the extended runway centreline before turning.

13B.3.44 The modelled current Category C & D routes are shown in blue on Figures 13B-3 and 13B-4.

13B.3.45 This approach is in accordance with EU Directive 2015/996 which states that "In many cases is not possible to model flight paths on the basis of radar data — because the necessary resources are not available or because the scenario is a future one for which there are no relevant radar data. In the absence of radar data, or when its use is inappropriate, it is necessary to estimate the flight paths on the basis of operational guidance material".

Dispersion

13B.3.46 Aircraft on departure are allocated a route to follow. In practice, this route is not followed precisely by all aircraft allocated to this route. The actual pattern of departing aircraft is dispersed about the route's centreline. The degree of dispersion is normally a function of the distance travelled by an aircraft along the route after take-off and also on the form of the route.

13B.3.47 When considering many departures, it is commonly found that the spread of aircraft approximates to a "normal distribution" pattern, the shape or spread of which will vary with distance along the route. A simplified mathematical model can be adopted to represent a normal distribution of events, based on standard deviations. EU Directive 2015/996 advises the use of seven "dispersed" tracks associated with each departure route, these comprise the Centreline of each route and the three Sub Tracks either side.

13B.3.48 The allocation of movements to each track for this assessment was as follows:

- 28.2% of departures along the Centreline;
- 22.2% of departures along each of the two inner Sub Tracks either side of the Centreline and offset by a distance of 0.71 standard deviation;
- 10.6% of departures along each of the 2nd pair of Sub Tracks either side of the Centreline and offset by a distance of 1.43 standard deviation;
- 3.1% of departures along each of the two outer Sub Tracks either side of the Centreline and offset by a distance of 2.14 standard deviations.

13B.3.49 This dispersion model has been applied with a departure offset profile, which comprises the standard deviations of the magnitude of the dispersion for lengths of straight and curved track. These have been determined from a detailed analysis of radar tracks for operations in 2016 at Dublin. Operations in 2018 have been reviewed and found to follow a similar distribution.

Route Usage

13B.3.50 The actual aircraft movement logs for years that have already occurred provide destination airports for each departure movement. This has been combined with an assessment that has been carried out of which departure route is used for each destination which utilise the direction it is from Dublin.

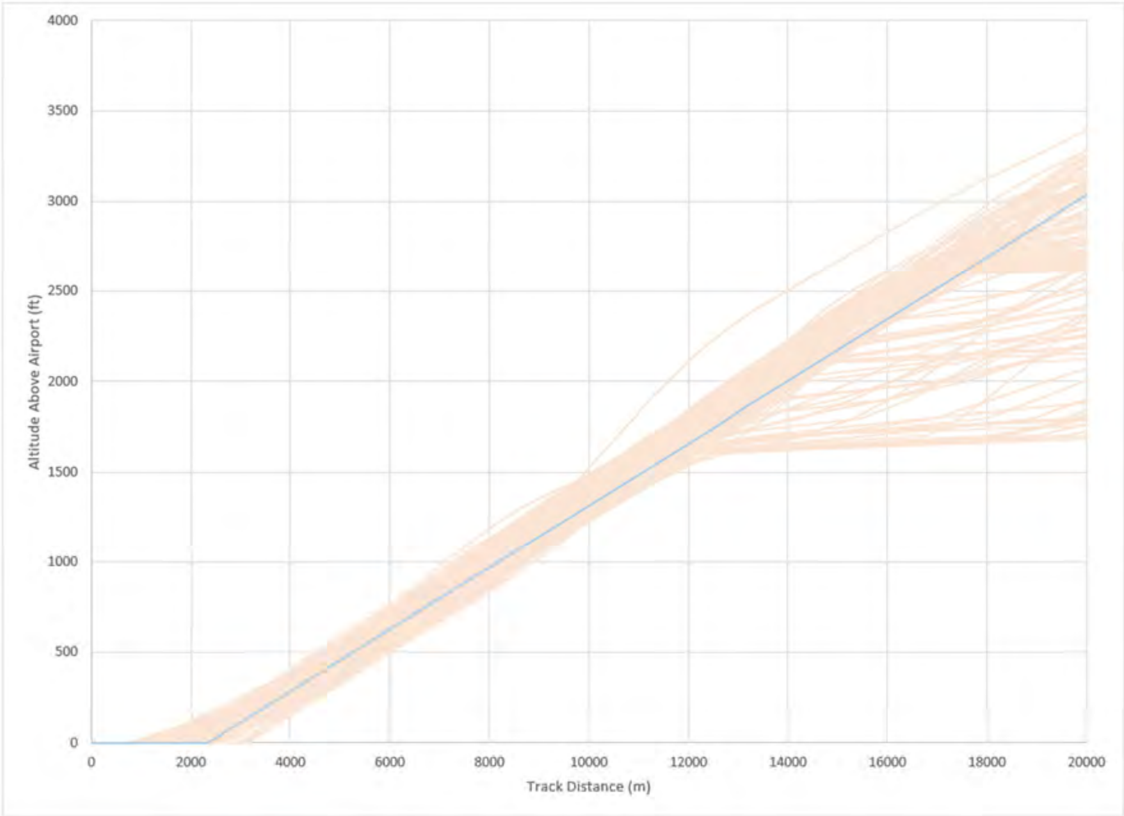
13B.3.51 The forecasts for future years generally include departure route information for each movement, which has been used. Where departure route information is not available, a departure route has been assigned based on the destination airport.

Flight Profiles

Arrival Profiles

13B.3.52 The standard arrival profiles for many of the aircraft in the AEDT database include level sections. Advice from the IAA is that aircraft routinely carry out continuous descent approach (CDA) procedures at Dublin Airport. Analysis of radar data confirms that this is the case for the large majority of arrivals in the vicinity of the airport. Therefore 3 degree CDA profiles have been created and used for all aircraft types. Chart 13B-1 below compares the modelled “USER” profile for the Airbus A320ceo with the radar tracks for a representative sample of arrivals by this aircraft in 2018. The Airbus A320ceo is one of the most common types operating at the airport. Any level sections also end at least 12 km from the airport, which for arrivals from the east (i.e. the majority), means the aircraft are over the sea at the time.

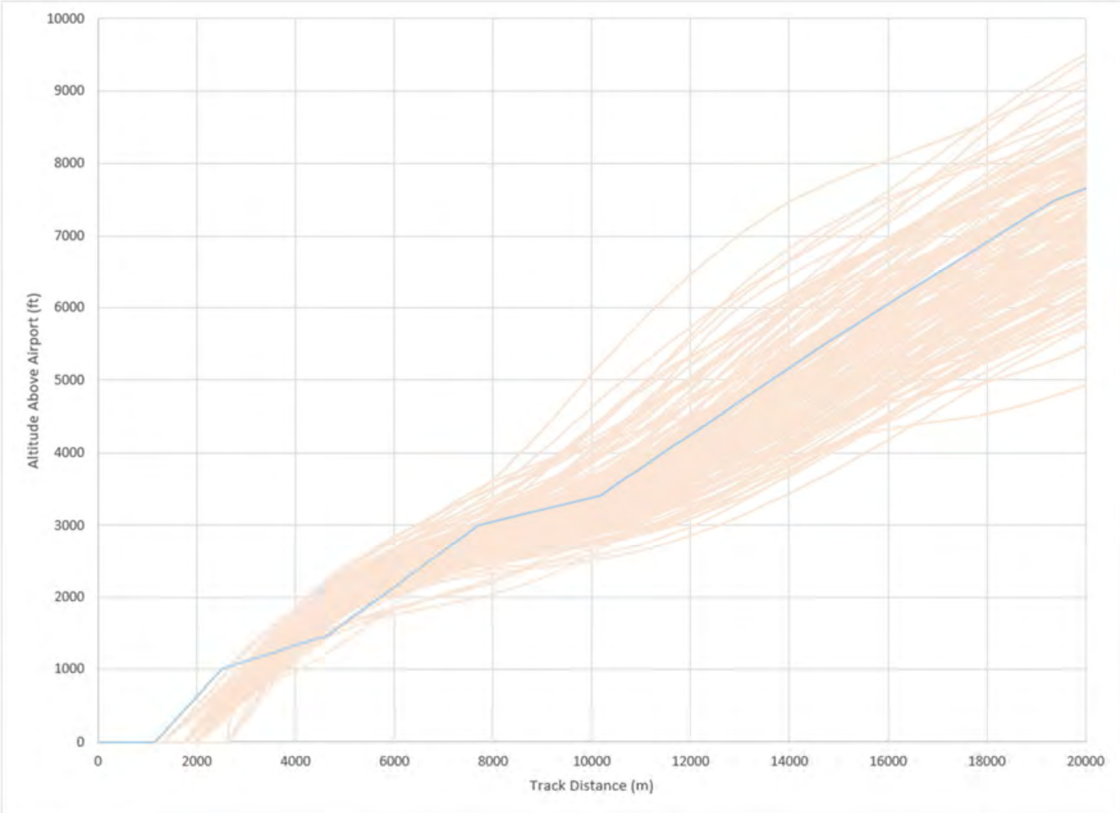
Chart 13B-1: Comparison of "USER" Arrival Profile and Radar Tracks for Airbus A320ceo



Departure Profiles

13B.3.53 For the most common aircraft, i.e. the Airbus A320ceo and Boeing 737-800, based on confidential information provided by airlines, custom profiles, denoted "USER", have been created that more closely replicate the procedures used by aircraft departing from Dublin Airport. These profiles broadly replicate NADP2 procedures with a lower initial thrust than maximum on take-off. The "USER" profiles were created by modifying the default departure profiles in AEDT. These modifications include changing the altitude where thrust is reduced and the speed at which flaps are retracted, where this information was available. The resulting modelled departure profiles have been compared against radar data to check that they are representative of the actual radar data. The SEL noise levels when using the "USER" profiles were also compared with the measured noise levels at the NMTs to check that these profiles did not result in excessive deviations from measured noise results. Chart 13B-2 below compares the modelled "USER" profile for the Airbus A320ceo at the most common stage length with the radar tracks for a representative sample of departures by this aircraft in 2018.

Chart 13B-2: Comparison of "USER" Profile and Radar Tracks for Airbus A320ceo



13B.3.54 For other similar aircraft which operate in large numbers in some or all of the modelled scenarios, specifically the A320neo, A321ceo, A321neo and Boeing 737 MAX modifications to the default AEDT profiles were applied on the same basis.

13B.3.55 The AEDT departure profiles for many of the aircraft in the AEDT database finish at 10,000 ft. To allow predictions over the whole of the study area the departure profiles for all aircraft have been extended to 30,000 ft or for certain aircraft the maximum altitude AEDT calculates to be achievable for the particular aircraft type. These user-defined profiles have been denoted "30KFT", other than those denoted "USER" as described above.

13B.3.56 This approach is in line with EU Directive 2015/996 which advises that "Caution must be exercised before adopting default procedural steps provided in the ANP database (customarily assumed when actual procedures are not known). These are standardised procedures that are widely followed but which may or may not be used by operators in particular cases".

Stage Lengths

13B.3.57 For departure movements the AEDT software offers a number of flight profiles for most aircraft types, and in particular for 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 and is in increments of 500 nm up to 1,500 nm and then in increments of 1,000 nm. The AEDT software assumes all aircraft take off with a full passenger load irrespective of stage length. 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.

13B.3.58 For some of the aircraft types, in particular the smaller aircraft, only one stage length is available in the AEDT software. For the remainder a stage length was chosen based on the distance to the destination airport.

13B.3.59 This approach complies with EU Directive 2015/996 which states that "Vertical dispersion is usually represented satisfactorily by accounting for the effects of varying aircraft weights on the vertical profiles."

AEDT Validation

13B.3.60 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 2018 have been used.

13B.3.61 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. A number of parameters are measured by the system, and for this validation the Sound Exposure Level (SEL) of the individual aircraft movements has been used.

13B.3.62 To take into account the measured levels the AEDT software has been used to predict the level at the NMT locations using the recommended AEDT aircraft type. This has been compared to the measured averages for the aircraft types 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.

13B.3.63 Seventeen aircraft have had modifications made to their arrival and departure noise assumptions. The modifications are detailed in Table 13B-15 below.

Table 13B-15: Modifications to AEDT Default Assumptions

Aircraft Type	Arrivals		Departures		
	AEDT Type	Adjustment (dB)	AEDT Type	Profile	Adjustment (dB)
A306	A300-622R	-3.1	A300-622R	30KFT	+0.6
A319	A319-131	-1.4	A319-131	30KFT	+0.9
A320	A320-211	-0.7	A320-211	USER	-1.3
A320neo	A320-211	-2.0	A320-211	USER	-3.2
A321	A321-232	-0.4	A321-232	USER	-0.5
A332	A330-301	-1.3	A330-301	30KFT	-1.1
A333	A330-301	-1.1	A330-301	30KFT	-0.8
ATR72	SD330	+1.5	SD330	30KFT [2]	+0.1[3]
B734	737400	+0.4	737400	30KFT	-0.1
B738	737800	-2.7	737800	USER	-1.2
B738MAX	7878max	-3.0	7378max	USER	-1.5
B752	757RR	-0.4	757RR	30KFT	-2.3
B772	777200	+0.2	777200	30KFT	+1.5
B773	777300	-0.8	777300	30KFT	-2.4
B787	7878R	-0.3	7878R	30KFT	+0.1
E190	EMB190	-0.8	EMB190	30KFT	+0.5
RJ85	BAE146	-3.3	BAE146	30KFT [2]	-1.6
DH4[1]	SD330	0	DHC6	30KFT [2]	0

[1] The DH4 type was not validated due to insufficient results. The modelled AEDT types are based on BAP's experience of this aircraft at other airports where it operates more frequently, as the default AEDT suggested type of DHC830 typically leads to significant under-prediction of noise levels.

[2] Maximum altitude limited to AEDT calculated max for the AEDT type.

[3] This aircraft does not routinely depart over NMT20 as it turns before reaching it, validation has therefore been based solely on measured results from NMTs 1 & 2.

13B.3.64 These modifications achieve a better correlation between predicted and measured noise at the airport, resulting in differences between predicted and measured levels of less than 1 dB at each of the three NMTs. The exception is the RJ85 which has a difference between modelled noise levels and measured noise levels at NMT20 of more than 2 dB. For this aircraft NMT20 correlates fewer departures than NMT2. It is possible that NMT20 is only recording the loudest departures by this aircraft, resulting in an average measured level that is not representative.

13B.3.65 This is in line with EU Directive 2015/996, which requires that "All input values affecting the emission level of a source, including the position of the source, shall be determined with at least the accuracy corresponding to an uncertainty of ± 2dB(A) in the emission level of the source".

Performance of Modernised Aircraft Types

13B.3.66 For the recently introduced and future aircraft types in the forecasts which are not contained within the AEDT model, assumptions have been made for their expected noise levels. This is based on a comparison with either the current generation aircraft that is being directly replaced, or the most similar aircraft type available in AEDT.

13B.3.67 The expected changes in noise levels are primarily based on a comparison of average certification noise levels between the current and modernised aircraft types from the *EASA Approved Noise Levels database*[3] undertaken in 2019. A summary of these is given in Table 13B-16. For aircraft whose certification noise levels were not available the assumptions are based on those used by the ERCD for the Airports Commission (2014)[4].

Table 13B-16: Summary of Entries in EASA Database for Relevant Aircraft Types

Aircraft Type	# Entries in EASA Database	Average of EASA Noise Certification Levels (EPNdB)		
		Lateral	Flyover	Approach
737700	1206	93.3	83.2	95.8
Airbus A321	1757	96.0	86.6	96.5
Airbus A321neo	561	88.7	84.1	94.5
Airbus A330-300	811	98.3	91.1	98.4
Airbus A330-900neo	5	92.4	88.9	98.4
Airbus A350-900	40	91.0	85.0	96.5
Bombardier CS300	16	87.1	80.8	92.4
Embraer E190	89	92.3	84.0	92.5
Embraer E190-E2	30	86.1	76.8	91.4

13B.3.68 For arrivals the approach level was utilised. For departures the average of the lateral and flyover levels was utilised. For each modernised aircraft type where an assumption was needed, the arrival and departure noise levels were separately compared with the relevant current aircraft type. These differences were then added to the adjustments set out in Table 13B-15 to give the resultant adjustments presented in Table 13B-17.

Table 13B-17: Expected Change in Noise Levels between Current and Modernised Aircraft Types

Current Aircraft Type	Modernised Aircraft Type	Expected Change in Noise Levels between Current and Modernised Aircraft Types (dB)	
		Arrival	Departure
737700	Bombardier CS300	-3.4	-4.3
Airbus A321	Airbus A321neo	-2.4	-5.4
Airbus A321	Airbus A321LR[1]	-2.4	-5.4
Airbus A330-300	Airbus A330-900neo	-1.1	-4.8
Airbus A330-300	Airbus A350-900	-3.0	-7.5
Boeing 777-300	Boeing 777X[2]	-0.8	-3.8
Embraer E190	Embraer E190-E2	-1.9	-6.2

[1] Based on A321neo certification noise levels
[2] Based on ERCD assumptions

[3] Latest version available at https://www.easa.europa.eu/easa-and-you/environment/easa-certification-noise-levels. Assessment used version dated 25th April 2019
[4] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/389579/noise_methodology_addendum.pdf

13B.4 Population and Demographics Assessment Methodology

Dwelling and Population Data

13B.4.1 Dwelling data has been acquired from GeoDirectory for 2019 Q2, which was the latest available dataset when the assessment work began. The same dataset has been used for all assessment scenarios in order to aid comparison between scenarios.

13B.4.2 An assessment of not yet built dwellings, which have already been granted planning permission, has been carried out. This has utilised information on permitted developments provided by Tom Phillips and Associates (TPA) in 2019, which has been compared to the 2019 Q2 data from GeoDirectory, as a number of the developments are progressing on site. This resulted in a separate consented dwellings database.

13B.4.3 Population data has been estimated using the average dwelling occupancy by small area. This has been obtained for 2016 based on Census data from the Central Statistics Office[5], by dividing the number of people by the number of dwellings for each small area. It has then been determined into which of the small areas each of the dwellings falls, based upon which they have been assigned the average dwelling occupancy for the relevant area. This approach is in line with that used for the last round of Noise Mapping.

13B.4.4 An assessment of zoned land has also been undertaken. This identified a number of areas which are designated for residential use. Some of these already contain existing or permitted dwellings and so are included in those datasets. The remaining areas have been assumed to have future developments with an average density of 35 dwellings per hectare and 3 people per dwelling. The dwelling density is based on a recent planning history search for the various sites and relevant local area plans. 3 people per dwelling is a conservative estimate based on the 2016 Census data, which found an average occupancy of a little under 3 people per dwelling for the study area.

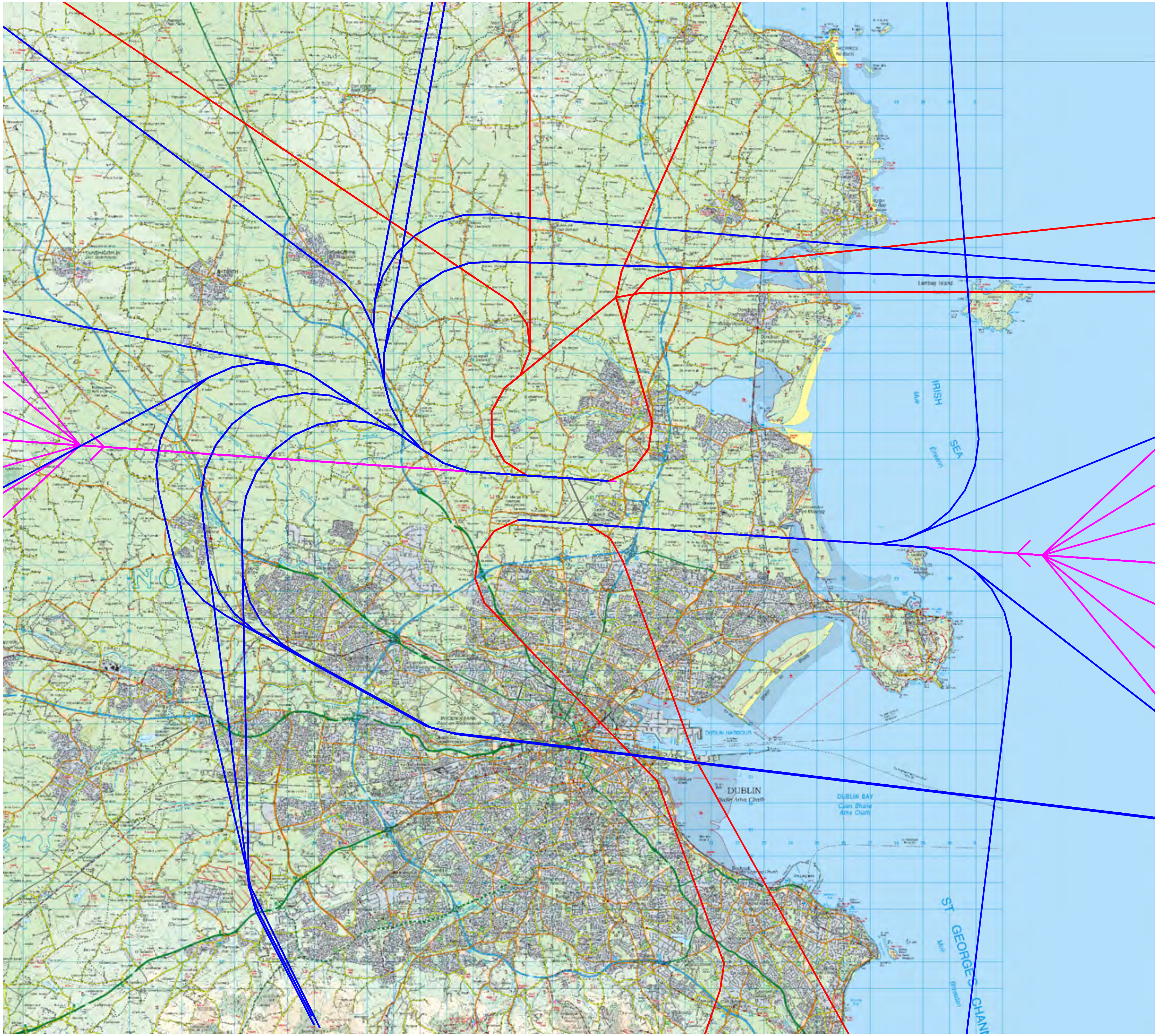
Community Buildings

13B.4.5 Noise sensitive community buildings have been identified through a review of the GeoDirectory data. For the purposes of this assessment noise sensitive education buildings include nurseries, schools, colleges and universities, but not day-care or creches. Noise sensitive healthcare buildings include healthcare facilities where people may have an overnight stay such as hospitals or nursing homes, but not GP surgeries or dentists.

Noise prediction

13B.4.6 Each dwelling and community building has been included in the AEDT model as a receptor. A representative set of receptors has been created for each permitted development and zoned land area based on site plans and other publicly available information. Noise levels have been predicted at each of these receptor locations.

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



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LEGEND:

Category A&B Aircraft Departure Route Centrelines

Category C&D Aircraft Departure Route Centrelines

Arrival Routes

Rev	Date	Description	Initials

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Dublin Airport
Change to Permitted Runway Operations

Figure 13B-3
Main Runway Modelled Routes
Future Segregated Mode

DRAWN: DR

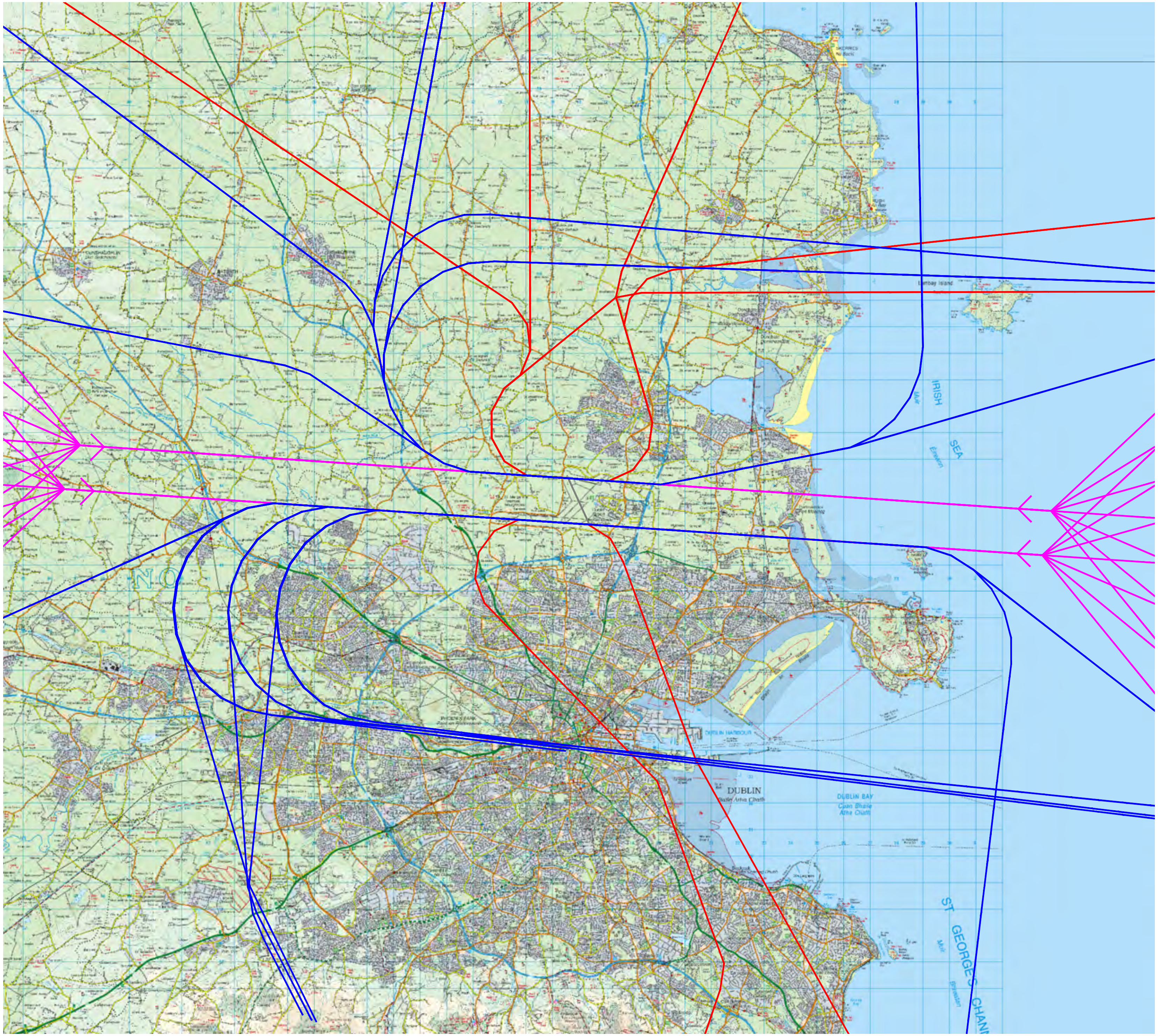
CHECKED: DC

DATE: August 2021

SCALE: 1:200000@A4

FIGURE No:

A11267_19_DR827_2.0



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LEGEND:

Category A&B Aircraft Departure Route Centrelines

Category C&D Aircraft Departure Route Centrelines

Arrival Routes

Rev	Date	Description	Initials

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Dublin Airport
Change to Permitted Runway Operations

Figure 13B-4
Main Runway Modelled Routes
Future Mixed Mode

DRAWN: DR | CHECKED: DC

DATE: August 2021 | SCALE: 1:200000@A4

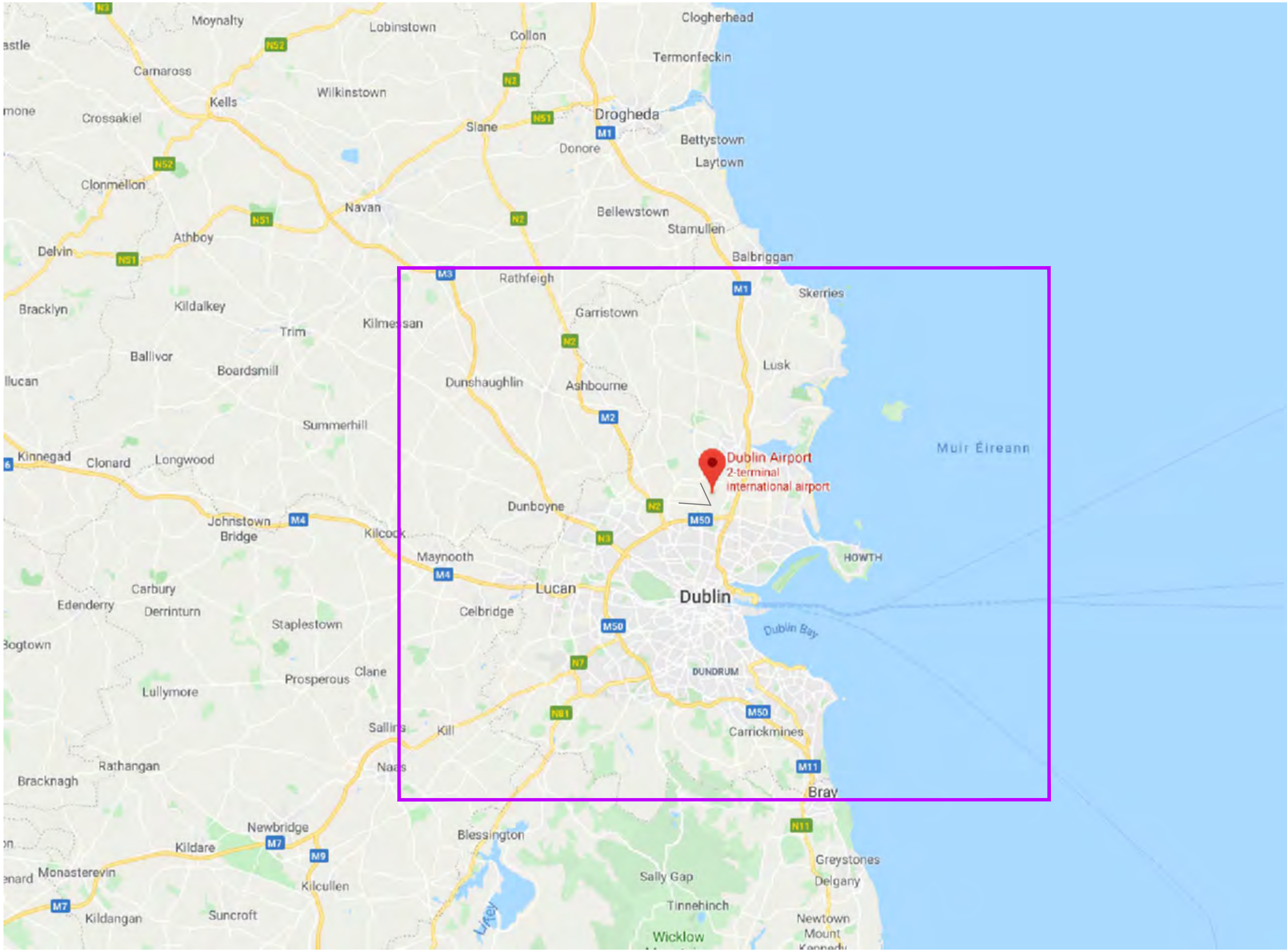
FIGURE No:

A11267_19_DR828_2.0

Map data ©2021 Google.

LEGEND:

Air Noise Study Area



Rev	Date	Description	Initials

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Dublin Airport
Change to Permitted Runway Operations

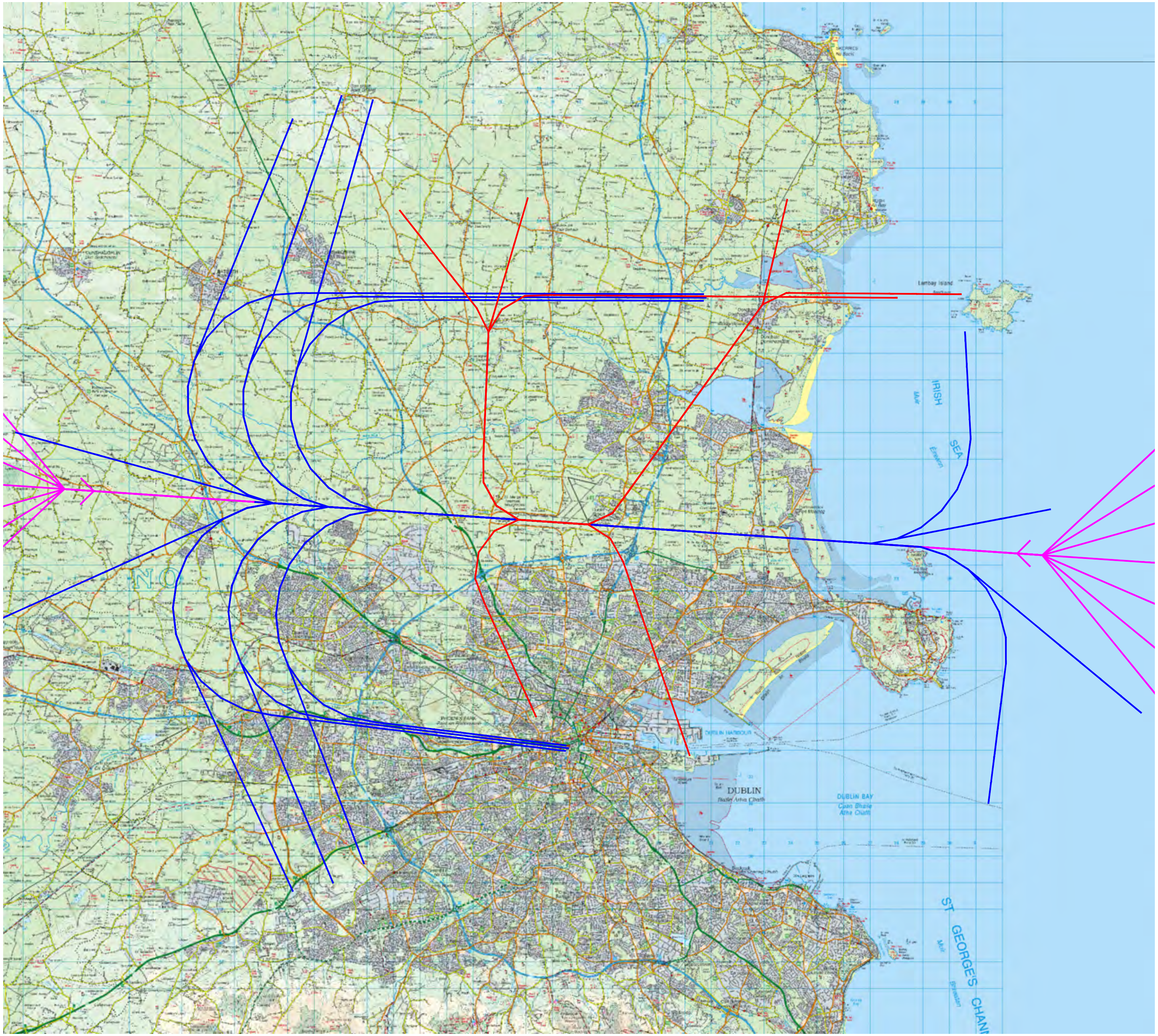
Figure 13B-1
Air Noise Study Area

DRAWN: NW CHECKED: DC

DATE: Aug 2021 SCALE: 1:500000@A4

FIGURE No:

A11267_19_DR825_1.0



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LEGEND:

- Category A&B Aircraft Departure Route Centrelines
- Category C&D Aircraft Departure Route Centrelines
- Arrival Routes

Rev	Date	Description	Initials

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Dublin Airport
Change to Permitted Runway Operations

Figure 13B-2
Main Runway Modelled Routes
Current

DRAWN: DR CHECKED: DC

DATE: August 2021 SCALE: 1:200000@A4

FIGURE No:

A11267_19_DR826_2.0

Appendix 13C. Air Noise Modelling Results

Document Classification: Class 1 - General

13C. Air noise modelling results and figures

13C.1 Introduction

13C.1.1 This appendix of the Environmental Impact Assessment Report (EIAR), prepared by Bickerdike Allen Partners LLP (BAP), presents the results of the air noise modelling. The modelling methodology, including the derivation of the dwelling and population counts, is described in Appendix 13B.

13C.2 Assessment Scenarios

13C.2.1 Seven scenarios have been included in the air noise assessment, these are:

- 2018
- 2022 Permitted
- 2022 Proposed
- 2025 Permitted
- 2025 Proposed
- 2035 Permitted
- 2035 Proposed

13C.3 Assessment Metrics

13C.3.1 For each assessment scenario, except 2018 the following metrics have been assessed. For 2018 all the metrics except L_{night} East, L_{night} West, N60 East and N60 West were assessed:

- L_{den}, the average annual 24-hour noise level with a 5 dB penalty applied during the evening (19:00-23:00) and a 10 dB penalty applied during the night (23:00-07:00)
- L_{night}, the average annual noise level at night (23:00-07:00)
- $L_{Aeq,16h}$, the average summer noise level during the 16-hour day (07:00-23:00)
- $L_{Aeq,8h}$, the average summer noise level during the night (23:00-07:00)
- N65, the number of aircraft exceeding 65 dB L_{Amax} during the average summer day (07:00-23:00)
- N60, the number of aircraft exceeding 60 dB L_{Amax} during the average summer night (23:00-07:00)
- L_{day}, the average annual noise level during the 12-hour day (07:00-19:00)
- $L_{evening}$, the average annual noise level during the evening (19:00-23:00)
- L_{night} East, the theoretical L_{night} noise level with all easterly operations
- L_{night} West, the theoretical L_{night} noise level with all westerly operations
- N60 East, the theoretical N60 value with all easterly operations
- N60 West, the theoretical N60 value with all westerly operations
- $L_{Aeq,1h}$, the average annual noise level during the specified hour
- L_{Amax}, the maximum noise level due to individual aircraft events

13C.3.2 Summer refers to the 92-day period between 16 June and 15 September inclusive. This typically corresponds to the busiest period of the year.

13C.3.3 For all metrics except for $L_{Aeq,1h}$ and L_{Amax}, contour plots have been produced and presented in figures, with the area, number of dwellings, population and number of community buildings within each contour presented in a series of tables.

13C.4 Assessment Results

Figures

13C.4.1 For each relevant assessment scenario and metric, the results are first presented in a series of figures showing contours on an Ordnance Survey Ireland base map. Table 13C-1 provides a reference to aid finding a specific figure.

Table 13C-1: Contour Figure References

Scenario	Metric and Figure Reference											
	L_{den}	L_{night}	$L_{Aeq,16h}$	$L_{Aeq,8h}$	N65	N60	L_{day}	$L_{evening}$	L_{night} East	L_{night} West	N60 East	N60 West
2018	13C-1	13C-2	13C-3	13C-4	13C-5	13C-6	13C-7	13C-8	-	-	-	-
2022 Permitted	13C-9	13C-10	13C-11	13C-12	13C-13	13C-14	13C-15	13C-16	13C-57	13C-58	13C-59	13C-60
2022 Proposed	13C-17	13C-18	13C-19	13C-20	13C-21	13C-22	13C-23	13C-24	13C-61	13C-62	13C-63	13C-64
2025 Permitted	13C-25	13C-26	13C-27	13C-28	13C-29	13C-30	13C-31	13C-32	13C-65	13C-66	13C-67	13C-68
2025 Proposed	13C-33	13C-34	13C-35	13C-36	13C-37	13C-38	13C-39	13C-40	13C-69	13C-70	13C-71	13C-72
2035 Permitted	13C-41	13C-42	13C-43	13C-44	13C-45	13C-46	13C-47	13C-48	13C-73	13C-74	13C-75	13C-76
2035 Proposed	13C-49	13C-50	13C-51	13C-52	13C-53	13C-54	13C-55	13C-56	13C-77	13C-78	13C-79	13C-80

Contour Areas, Dwelling and Population Counts

13C.4.2 For each assessment scenario and metric, the tables below present the area of each contour, as well as the number of dwellings and people within it. The dwelling and population counts are presented in three categories:

- Existing dwellings
- Permitted dwellings, i.e. those with planning permission that are not yet built
- Zoned dwellings, i.e. those that are expected to be built in areas zoned for residential development.

All of the areas and counts below are cumulative, i.e. the people within a 60 dB contour would also be counted as within the corresponding 50 dB contour.

13C.4.3 Table 13C-2 provides a reference to aid finding a specific result.

Table 13C-2: Contour Area, Dwelling and Population Count Table References

Metric	Result Item and Table Reference						
	Contour Areas	Existing Dwelling Counts	Permitted Dwelling Counts	Zoned Dwelling Counts	Existing Population Counts	Permitted Population Counts	Zoned Population Counts
L_{den}	Table 13C-3	Table 13C-15	Table 13C-27	Table 13C-39	Table 13C-51	Table 13C-63	Table 13C-75
L_{night}	Table 13C-4	Table 13C-16	Table 13C-28	Table 13C-40	Table 13C-52	Table 13C-64	Table 13C-76
$L_{Aeq,16h}$	Table 13C-5	Table 13C-17	Table 13C-29	Table 13C-41	Table 13C-53	Table 13C-65	Table 13C-77
$L_{Aeq,8h}$	Table 13C-6	Table 13C-18	Table 13C-30	Table 13C-42	Table 13C-54	Table 13C-66	Table 13C-78
N65	Table 13C-7	Table 13C-19	Table 13C-31	Table 13C-43	Table 13C-55	Table 13C-67	Table 13C-79
N60	Table 13C-8	Table 13C-20	Table 13C-32	Table 13C-44	Table 13C-56	Table 13C-68	Table 13C-80
L_{day}	Table 13C-9	Table 13C-21	Table 13C-33	Table 13C-45	Table 13C-57	Table 13C-69	Table 13C-81
$L_{evening}$	Table 13C-10	Table 13C-22	Table 13C-34	Table 13C-46	Table 13C-58	Table 13C-70	Table 13C-82
L_{night} East	Table 13C-11	Table 13C-23	Table 13C-35	Table 13C-47	Table 13C-59	Table 13C-71	Table 13C-83
L_{night} West	Table 13C-12	Table 13C-24	Table 13C-36	Table 13C-48	Table 13C-60	Table 13C-72	Table 13C-84
N60 East	Table 13C-13	Table 13C-25	Table 13C-37	Table 13C-49	Table 13C-61	Table 13C-73	Table 13C-85
N60 West	Table 13C-14	Table 13C-26	Table 13C-38	Table 13C-50	Table 13C-62	Table 13C-74	Table 13C-86

Table 13C-3: Contour Areas, L_{den} Metric

Metric Value, dB L_{den}	Scenario and Contour Area, km^2						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	703.2	432.2	499.6	535.2	714.3	350.5	410.3
≥ 50	209.3	162.3	185.3	186.5	218.1	148.5	168.1
≥ 55	85.9	67.6	76.9	80.7	93.8	63.6	73.2
≥ 60	33.5	26.4	30.2	31.4	36.6	24.3	28.1
≥ 65	11.6	9.2	11.1	11.2	13.4	8.0	9.4

≥ 70	4.1	3.3	4.0	3.9	4.7	2.9	3.4
≥ 75	1.7	1.3	1.5	1.6	1.9	1.2	1.4

Table 13C-4: Contour Areas, L_{night} Metric

Metric Value, dB L_{night}	Scenario and Contour Area, km^2						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	304.4	170.7	248.5	196.8	311.5	149.9	227.4
≥ 45	118.2	75.1	116.3	85.9	128.7	68.5	105.1
≥ 50	48.4	29.0	45.2	34.6	55.0	26.6	43.0
≥ 55	16.8	10.1	16.9	12.0	20.8	9.0	14.7
≥ 60	5.8	3.5	5.8	4.2	6.9	3.0	5.1
≥ 65	2.3	1.4	2.2	1.6	2.7	1.2	2.0
≥ 70	1.0	0.6	0.9	0.7	1.1	0.5	0.8

Table 13C-5: Contour Areas, $L_{Aeq,16h}$ Metric

Metric Value, dB $L_{Aeq,16h}$	Scenario and Contour Area, km^2						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 51	111.7	98.7	100.0	87.1	113.7	90.4	85.8
≥ 54	68.2	56.6	57.1	50.3	66.1	52.0	49.3
≥ 57	38.7	32.4	32.7	28.9	37.5	29.8	28.3
≥ 60	20.7	18.9	19.1	16.5	21.5	15.9	15.1
≥ 63	11.1	10.3	10.5	8.9	11.8	8.7	8.3
≥ 66	6.0	5.7	5.8	4.9	6.5	4.7	4.5
≥ 69	3.2	3.1	3.2	2.7	3.6	2.6	2.5

Table 13C-6: Contour Areas, $L_{Aeq,8h}$ Metric

Metric Value, dB $L_{Aeq,8h}$	Scenario and Contour Area, km²						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	132.1	85.1	131.5	91.8	137.4	73.4	111.9
≥ 48	79.3	50.2	75.5	55.2	84.8	43.0	67.6
≥ 51	45.9	27.6	43.3	30.7	49.3	23.5	38.6
≥ 54	24.5	14.7	24.4	16.2	27.7	12.3	20.5
≥ 57	12.7	7.7	12.8	8.5	14.5	6.3	10.3
≥ 60	6.7	4.1	6.8	4.5	7.5	3.3	5.5
≥ 63	3.7	2.3	3.7	2.5	4.2	1.8	3.1

Table 13C-7: Contour Areas, N65 Metric

Metric Value, N65	Scenario and Contour Area, km²						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	161.7	158.6	159.6	182.4	181.2	139.7	131.9
≥ 25	105.3	114.9	117.0	118.3	119.5	88.9	85.7
≥ 50	73.9	81.6	83.0	86.4	86.7	65.6	64.0
≥ 100	60.3	47.7	48.6	55.6	54.8	42.5	40.7
≥ 200	40.7	23.9	24.5	29.2	29.3	24.7	24.0
≥ 500	1.8	0.0	0.0	0.0	0.0	0.0	0.0

Table 13C-8: Contour Areas, N60 Metric

Metric Value, N60	Scenario and Contour Area, km²						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	147.9	99.3	144.2	107.2	139.4	86.4	113.7
≥ 25	76.3	15.5	52.9	52.4	69.0	43.0	57.0
≥ 50	7.2	0.0	4.9	1.2	7.2	1.1	5.1
≥ 100	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 13C-9: Contour Areas, L_{day} Metric

Metric Value, dB L_{day}	Scenario and Contour Area, km²						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	376.1	263.3	269.6	347.4	353.2	247.8	234.5
≥ 50	130.4	106.1	108.0	132.8	133.8	104.8	99.7
≥ 55	55.9	42.0	42.5	53.7	53.6	42.0	40.0
≥ 60	20.3	17.0	17.2	21.4	21.2	15.3	14.7
≥ 65	7.2	6.2	6.3	7.9	7.9	5.6	5.4
≥ 70	2.7	2.3	2.4	2.9	2.9	2.1	2.0
≥ 75	1.1	0.9	0.9	1.2	1.2	0.9	0.8

Table 13C-10: Contour Areas, $L_{evening}$ Metric

Metric Value, dB $L_{evening}$	Scenario and Contour Area, km²						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	276.5	223.6	225.8	253.4	244.8	194.6	184.3
≥ 50	99.5	93.7	93.6	105.4	101.8	85.7	80.4
≥ 55	40.4	36.8	36.7	41.9	40.1	33.9	31.9
≥ 60	14.1	14.3	14.5	16.3	15.8	12.3	11.5
≥ 65	5.0	5.1	5.2	5.8	5.6	4.3	4.0
≥ 70	1.9	1.9	1.9	2.1	2.1	1.5	1.5
≥ 75	0.8	0.7	0.7	0.8	0.8	0.6	0.6

Table 13C-11: Contour Areas, L_{night} East Metric

Metric Value, dB $L_{evening}$	Scenario and Contour Area, km²						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	-	188.7	260.5	220.6	331.8	155.6	237.7
≥ 45	-	79.0	117.1	90.8	145.1	70.3	116.1
≥ 50	-	28.8	44.7	34.3	57.4	26.4	45.0
≥ 55	-	9.9	14.3	11.7	20.1	8.8	14.5
≥ 60	-	3.5	4.9	4.1	6.7	3.0	4.7
≥ 65	-	1.2	1.7	1.4	2.2	1.0	1.5
≥ 70	-	0.4	0.6	0.5	0.8	0.3	0.6

Table 13C-12: Contour Areas, L_{night} West Metric

Metric Value, dB $L_{evening}$	Scenario and Contour Area, km²						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	-	180.5	261.2	214.7	326.9	147.1	215.4
≥ 45	-	72.8	102.4	83.2	121.6	67.0	96.7
≥ 50	-	28.7	44.8	34.0	54.2	26.4	43.6
≥ 55	-	10.1	16.8	11.9	20.9	8.9	15.1
≥ 60	-	3.6	5.6	4.2	7.1	3.1	5.1
≥ 65	-	1.3	2.0	1.5	2.4	1.0	1.7
≥ 70	-	0.5	0.8	0.5	0.9	0.4	0.6

Table 13C-13: Contour Areas, N60 East Metric

Metric Value, dB $L_{evening}$	Scenario and Contour Area, km²						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	-	120.2	158.9	128.9	188.3	87.8	146.9
≥ 25	-	17.5	88.0	74.0	85.4	60.3	65.7
≥ 50	-	0.0	4.5	3.0	7.4	2.4	3.5
≥ 100	-	0.0	0.0	0.0	0.0	0.0	0.0

Table 13C-14: Contour Areas, N60 West Metric

Metric Value, dB $L_{evening}$	*Scenario and Contour Area, km²*						
	2018	*2022 Permitted*	*2022 Proposed*	*2025 Permitted*	*2025 Proposed*	*2035 Permitted*	*2035 Proposed*
≥ 10	-	106.0	132.9	111.7	151.7	80.5	112.6
≥ 25	-	17.4	65.5	63.1	63.7	53.3	50.8
≥ 50	-	0.0	5.3	3.1	26.8	2.6	25.1
≥ 100	-	0.0	0.0	0.0	0.0	0.0	0.0

Table 13C-15: Existing Dwelling Counts, L_{den} Metric

Metric Value, dB L_{den}	*Scenario and Existing Dwelling Count*						
	2018	*2022 Permitted*	*2022 Proposed*	*2025 Permitted*	*2025 Proposed*	*2035 Permitted*	*2035 Proposed*
≥ 45	245,808	112,351	118,213	141,352	172,343	72,661	85,894
≥ 50	61,728	26,107	28,176	32,524	43,545	19,077	22,148
≥ 55	11,889	4,492	6,061	6,571	8,837	3,344	4,173
≥ 60	1,641	492	696	699	1,136	480	777
≥ 65	94	31	47	40	67	23	36
≥ 70	10	4	7	6	10	2	2
≥ 75	2	0	0	0	0	0	0

Table 13C-16: Existing Dwelling Counts, L_{night} Metric

Metric Value, dB L_{night}	*Scenario and Existing Dwelling Count*						
	2018	*2022 Permitted*	*2022 Proposed*	*2025 Permitted*	*2025 Proposed*	*2035 Permitted*	*2035 Proposed*
≥ 40	102,538	45,205	45,937	53,627	88,761	27,161	45,118
≥ 45	18,815	9,421	11,526	11,422	18,582	6,981	9,438
≥ 50	4,131	1,192	1,936	2,077	2,962	1,177	1,967
≥ 55	276	82	120	101	335	75	148
≥ 60	19	9	14	10	18	7	12
≥ 65	3	0	0	2	2	0	0
≥ 70	0	0	0	0	0	0	0

Table 13C-17: Existing Dwelling Counts, $L_{Aeq,16h}$ Metric

Metric Value, dB $L_{Aeq,16h}$	Scenario and Existing Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 51	16,459	9,738	10,002	8,275	11,701	6,216	5,858
≥ 54	7,898	3,463	3,596	2,497	4,528	2,209	2,004
≥ 57	2,944	755	716	701	1,135	815	700
≥ 60	694	143	146	103	227	124	102
≥ 63	96	49	50	36	54	36	36
≥ 66	53	19	21	10	26	12	10
≥ 69	9	3	3	0	3	0	0
≥ 72	2	0	0	0	0	0	0

Table 13C-18: Existing Dwelling Counts, $L_{Aeq,8h}$ Metric

Metric Value, dB $L_{Aeq,8h}$	Scenario and Existing Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	22,732	11,360	15,030	12,587	20,971	7,751	10,560
≥ 48	8,929	4,666	4,904	5,626	8,245	3,263	4,365
≥ 51	3,310	987	1,820	1,454	2,387	887	1,734
≥ 54	880	204	479	320	694	103	466
≥ 57	105	63	65	67	103	40	56
≥ 60	42	10	18	10	18	8	13
≥ 63	10	5	7	6	6	2	2
≥ 66	2	0	0	1	1	0	0

Table 13C-19: Existing Dwelling Counts, N65 Metric

Metric Value, N65	Scenario and Existing Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	34,035	15,904	15,947	19,600	18,833	12,744	11,426
≥ 25	22,375	13,057	13,289	13,555	13,430	5,656	5,348
≥ 50	8,476	6,854	7,056	7,557	7,368	2,779	2,576
≥ 100	5,915	1,944	2,023	2,032	2,350	1,601	1,547
≥ 200	3,546	1,247	1,250	1,326	1,326	1,185	1,175
≥ 500	0	0	0	0	0	0	0

Table 13C-20: Existing Dwelling Counts, N60 Metric

Metric Value, N60	Scenario and Existing Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	22,727	13,938	15,852	15,027	18,959	9,013	9,754
≥ 25	8,037	118	3,086	4,952	5,282	4,051	4,241
≥ 50	30	0	23	5	39	5	33
≥ 100	0	0	0	0	0	0	0

Table 13C-21: Existing Dwelling Counts, L_{day} Metric

Metric Value, dB L_{day}	Scenario and Existing Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	122,813	44,292	45,893	69,619	69,989	38,651	34,330
≥ 50	25,177	10,823	11,264	16,114	15,488	8,264	7,629
≥ 55	5,757	1,621	1,688	2,567	2,733	1,631	1,513
≥ 60	530	126	127	206	187	102	92
≥ 65	64	26	26	32	36	18	16
≥ 70	6	0	0	0	1	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-22: Existing Dwelling Counts, $L_{evening}$ Metric

Metric Value, dB $L_{evening}$	Scenario and Existing Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	81,266	37,095	37,911	42,114	40,708	25,611	23,818
≥ 50	15,746	9,039	9,191	10,670	10,080	5,832	5,377
≥ 55	2,873	1,289	1,208	1,623	1,532	1,268	1,055
≥ 60	117	86	88	106	98	68	61
≥ 65	10	12	15	20	19	7	5
≥ 70	2	0	0	0	0	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-23: Existing Dwelling Counts, L_{night} East Metric

Metric Value, dB $L_{evening}$	Scenario and Existing Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	-	13,227	18,986	16,498	30,413	9,373	17,588
≥ 45	-	1,299	3,387	2,579	4,783	773	1,300
≥ 50	-	114	256	252	365	186	303
≥ 55	-	7	16	14	19	10	15
≥ 60	-	0	4	2	0	0	0
≥ 65	-	0	0	0	0	0	0
≥ 70	-	0	0	0	0	0	0

Table 13C-24: Existing Dwelling Counts, L_{night} West Metric

Metric Value, dB $L_{evening}$	Scenario and Existing Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	-	46,209	40,739	≥60,606*	≥88,472*	27,127	41,580
≥ 45	-	8,398	8,413	10,271	16,760	6,405	8,238
≥ 50	-	1,493	1,717	2,537	3,205	1,323	2,017
≥ 55	-	92	289	115	447	81	373
≥ 60	-	9	17	14	20	8	12
≥ 65	-	1	0	2	2	0	0
≥ 70	-	0	0	0	0	0	0

* 2025 westerly contours extend beyond the dwelling and population dataset

Table 13C-25: Existing Dwelling Counts, N60 East Metric

Metric Value, dB $L_{evening}$	Scenario and Existing Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	-	28,269	32,809	31,399	44,807	12,527	23,703
≥ 25	-	234	13,698	10,766	9,835	6,519	5,943
≥ 50	-	0	23	8	199	6	88
≥ 100	-	0	0	0	0	0	0

Table 13C-26: Existing Dwelling Counts, N60 West Metric

Metric Value, dB $L_{evening}$	Scenario and Existing Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	-	13,744	11,018	15,869	25,333	7,104	9,313
≥ 25	-	162	5,116	6,210	3,372	5,038	2,490
≥ 50	-	0	23	13	2,060	8	2,053
≥ 100	-	0	0	0	0	0	0

Table 13C-27: Permitted Dwelling Counts, L_{den} Metric

Metric Value, dB L_{den}	Scenario and Permitted Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	7,079	6,468	6,711	6,818	6,919	5,844	6,220
≥ 50	5,406	3,218	3,412	3,451	3,854	2,938	3,139
≥ 55	2,013	1,555	1,442	1,771	1,907	1,555	1,693
≥ 60	814	257	300	300	329	270	300
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-28: Permitted Dwelling Counts, L_{night} Metric

Metric Value, dB L_{night}	Scenario and Permitted Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	5,484	4,998	3,680	5,267	6,047	3,231	3,854
≥ 45	2,983	1,898	2,427	2,249	3,099	1,844	2,315
≥ 50	877	814	425	843	1,030	814	843
≥ 55	52	0	0	0	104	0	0
≥ 60	0	0	0	0	0	0	0
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0

Table 13C-29: Permitted Dwelling Counts, $L_{Aeq,16h}$ Metric

Metric Value, dB $L_{Aeq,16h}$	Scenario and Permitted Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 51	2,909	1,791	1,836	1,771	1,958	1,475	1,369
≥ 54	1,617	802	802	789	1,061	763	711
≥ 57	843	300	300	300	329	300	300
≥ 60	502	0	0	0	52	0	0
≥ 63	0	0	0	0	0	0	0
≥ 66	0	0	0	0	0	0	0
≥ 69	0	0	0	0	0	0	0

Table 13C-30: Permitted Dwelling Counts, $L_{Aeq,8h}$ Metric

Metric Value, dB $L_{Aeq,8h}$	Scenario and Permitted Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	3,001	2,226	2,679	2,628	3,242	1,867	2,473
≥ 48	1,817	1,290	1,699	1,316	1,903	877	1,555
≥ 51	843	784	391	814	877	691	750
≥ 54	468	32	270	32	332	0	257
≥ 57	0	0	0	0	0	0	0
≥ 60	0	0	0	0	0	0	0
≥ 63	0	0	0	0	0	0	0

Table 13C-31: Permitted Dwelling Counts, N65 Metric

Metric Value, N65	Scenario and Permitted Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	4,659	2,330	2,330	2,844	2,941	2,354	2,324
≥ 25	2,604	2,082	2,130	2,130	2,082	1,232	1,232
≥ 50	1,588	1,250	1,262	1,311	1,311	802	802
≥ 100	939	329	329	329	359	329	329
≥ 200	843	329	329	329	329	329	329
≥ 500	0	0	0	0	0	0	0

Table 13C-32: Permitted Dwelling Counts, N60 Metric

Metric Value, N60	Scenario and Permitted Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	3,615	2,482	2,641	2,728	2,812	2,327	2,327
≥ 25	1,803	0	1,211	1,670	1,725	1,394	1,555
≥ 50	0	0	0	0	0	0	0
≥ 100	0	0	0	0	0	0	0

Table 13C-33: Permitted Dwelling Counts, L_{day} Metric

Metric Value, dB L_{day}	Scenario and Permitted Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	6,115	3,302	3,362	5,582	5,807	3,778	3,575
≥ 50	3,078	1,958	1,958	2,413	2,260	1,857	1,791
≥ 55	1,290	329	329	776	672	329	329
≥ 60	190	0	0	0	0	0	0
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-34: Permitted Dwelling Counts, $L_{evening}$ Metric

Metric Value, dB $L_{evening}$	Scenario and Permitted Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	5,509	3,113	3,127	3,251	3,180	2,837	2,809
≥ 50	2,839	1,791	1,771	1,958	1,958	1,421	1,339
≥ 55	843	329	329	329	329	329	329
≥ 60	0	0	0	0	0	0	0
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-35: Permitted Dwelling Counts, L_{night} East Metric

Metric Value, dB $L_{evening}$	Scenario and Permitted Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	-	2,790	3,230	3,074	3,590	2,307	2,455
≥ 45	-	691	1,440	1,082	1,205	566	514
≥ 50	-	0	32	32	62	32	32
≥ 55	-	0	0	0	0	0	0
≥ 60	-	0	0	0	0	0	0
≥ 65	-	0	0	0	0	0	0
≥ 70	-	0	0	0	0	0	0

Table 13C-36: Permitted Dwelling Counts, L_{night} West Metric

Metric Value, dB $L_{evening}$	Scenario and Permitted Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	-	4,878	4,928	4,933	5,528	3,078	4,895
≥ 45	-	1,614	2,160	1,805	2,604	1,753	2,327
≥ 50	-	814	329	843	996	814	739
≥ 55	-	0	156	0	257	0	233
≥ 60	-	0	0	0	0	0	0
≥ 65	-	0	0	0	0	0	0
≥ 70	-	0	0	0	0	0	0

Table 13C-37: Permitted Dwelling Counts, N60 East Metric

Metric Value, dB $L_{evening}$	Scenario and Permitted Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	-	3,293	3,512	3,468	3,881	2,542	2,956
≥ 25	-	0	2,590	2,529	1,837	1,851	1,722
≥ 50	-	0	0	0	0	0	0
≥ 100	-	0	0	0	0	0	0

Table 13C-38: Permitted Dwelling Counts, N60 West Metric

Metric Value, dB $L_{evening}$	Scenario and Permitted Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	-	1,910	1,360	2,252	3,396	1,651	1,821
≥ 25	-	0	1,198	1,766	1,211	1,394	1,007
≥ 50	-	0	0	0	844	0	844
≥ 100	-	0	0	0	0	0	0

Table 13C-39: Zoned Dwelling Counts, L_{den} Metric

Metric Value, dB L_{den}	Scenario and Zoned Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	4,500	4,500	4,500	4,500	4,500	4,500	4,500
≥ 50	4,200	4,200	4,200	4,200	4,500	4,200	4,500
≥ 55	4,200	3,600	4,100	4,200	4,200	3,500	3,600
≥ 60	2,500	1,100	1,300	1,300	1,400	1,200	1,300
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-40: Zoned Dwelling Counts, L_{night} Metric

Metric Value, dB L_{night}	Scenario and Zoned Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	4,400	4,200	4,500	4,300	4,500	4,200	4,500
≥ 45	4,200	4,200	4,200	4,200	4,500	4,200	4,200
≥ 50	2,800	2,500	2,700	2,700	3,000	2,500	2,700
≥ 55	0	0	0	0	200	0	0
≥ 60	0	0	0	0	0	0	0
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0

Table 13C-41: Zoned Dwelling Counts, $L_{Aeq,16h}$ Metric

Metric Value, dB $L_{Aeq,16h}$	Scenario and Zoned Dwelling Count						
	2018	*2022 Permitted*	*2022 Proposed*	*2025 Permitted*	*2025 Proposed*	*2035 Permitted*	*2035 Proposed*
≥ 51	4,200	3,000	3,000	3,000	3,000	3,000	3,000
≥ 54	3,500	2,100	2,100	1,900	2,400	1,800	1,800
≥ 57	2,700	1,300	1,300	1,300	1,500	1,300	1,300
≥ 60	1,200	0	0	0	0	0	0
≥ 63	0	0	0	0	0	0	0
≥ 66	0	0	0	0	0	0	0
≥ 69	0	0	0	0	0	0	0

Table 13C-42: Zoned Dwelling Counts, $L_{Aeq,8h}$ Metric

Metric Value, dB $L_{Aeq,8h}$	Scenario and Zoned Dwelling Count						
	2018	*2022 Permitted*	*2022 Proposed*	*2025 Permitted*	*2025 Proposed*	*2035 Permitted*	*2035 Proposed*
≥ 45	4,200	4,200	4,200	4,200	4,500	4,200	4,200
≥ 48	3,600	3,100	4,200	3,500	4,200	3,000	3,500
≥ 51	2,700	2,500	2,300	2,500	2,800	2,500	2,700
≥ 54	1,700	0	1,100	100	1,500	0	1,100
≥ 57	0	0	0	0	0	0	0
≥ 60	0	0	0	0	0	0	0
≥ 63	0	0	0	0	0	0	0

Table 13C-43: Zoned Dwelling Counts, N65 Metric

Metric Value, N65	Scenario and Zoned Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	4,200	3,000	3,000	4,200	4,200	4,200	4,200
≥ 25	4,200	3,000	3,000	3,000	3,000	3,000	3,000
≥ 50	3,500	3,000	3,000	3,000	3,000	2,300	2,300
≥ 100	2,700	1,500	1,500	1,500	1,500	1,500	1,500
≥ 200	2,700	1,500	1,500	1,500	1,500	1,300	1,300
≥ 500	0	0	0	0	0	0	0

Table 13C-44: Zoned Dwelling Counts, N60 Metric

Metric Value, N60	Scenario and Zoned Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	4,200	4,200	4,200	4,200	4,200	4,200	4,200
≥ 25	3,600	0	2,400	3,600	3,600	3,100	3,100
≥ 50	0	0	0	0	0	0	0
≥ 100	0	0	0	0	0	0	0

Table 13C-45: Zoned Dwelling Counts, L_{day} Metric

Metric Value, dB L_{day}	Scenario and Zoned Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	4,500	3,300	3,300	4,500	4,500	4,500	4,500
≥ 50	4,200	3,000	3,000	3,100	3,000	3,000	3,000
≥ 55	3,100	1,500	1,500	1,800	1,800	1,600	1,500
≥ 60	800	0	0	0	0	0	0
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-46: Zoned Dwelling Counts, $L_{evening}$ Metric

Metric Value, dB $L_{evening}$	Scenario and Zoned Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	4,500	3,200	3,200	3,400	3,400	3,000	3,000
≥ 50	4,200	3,000	3,000	3,000	3,000	3,000	3,000
≥ 55	2,700	1,500	1,500	1,600	1,500	1,500	1,400
≥ 60	0	0	0	0	0	0	0
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-47: Zoned Dwelling Counts, L_{night} East Metric

Metric Value, dB $L_{evening}$	Scenario and Zoned Dwelling Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	-	4,200	4,200	4,200	4,500	4,200	4,500
≥ 45	-	2,600	4,000	3,500	3,500	1,400	1,400
≥ 50	-	0	300	400	800	0	800
≥ 55	-	0	0	0	0	0	0
≥ 60	-	0	0	0	0	0	0
≥ 65	-	0	0	0	0	0	0
≥ 70	-	0	0	0	0	0	0

Table 13C-48: Zoned Dwelling Counts, L_{night} West Metric

Metric Value, dB $L_{evening}$	*Scenario and Zoned Dwelling Count*						
	2018	*2022 Permitted*	*2022 Proposed*	*2025 Permitted*	*2025 Proposed*	*2035 Permitted*	*2035 Proposed*
≥ 40	-	4,200	4,200	4,200	4,300	4,200	4,200
≥ 45	-	3,100	4,200	3,600	4,200	3,500	4,200
≥ 50	-	2,500	1,500	2,500	2,800	2,500	2,300
≥ 55	-	0	300	0	1,100	0	1,000
≥ 60	-	0	0	0	0	0	0
≥ 65	-	0	0	0	0	0	0
≥ 70	-	0	0	0	0	0	0

Table 13C-49: Zoned Dwelling Counts, N60 East Metric

Metric Value, dB $L_{evening}$	*Scenario and Zoned Dwelling Count*						
	2018	*2022 Permitted*	*2022 Proposed*	*2025 Permitted*	*2025 Proposed*	*2035 Permitted*	*2035 Proposed*
≥ 10	-	4,500	4,500	4,500	4,500	4,200	4,500
≥ 25	-	0	4,200	4,200	4,500	4,200	4,200
≥ 50	-	0	0	0	0	0	0
≥ 100	-	0	0	0	0	0	0

Table 13C-50: Zoned Dwelling Counts, N60 West Metric

Metric Value, dB $L_{evening}$	*Scenario and Zoned Dwelling Count*						
	2018	*2022 Permitted*	*2022 Proposed*	*2025 Permitted*	*2025 Proposed*	*2035 Permitted*	*2035 Proposed*
≥ 10	-	3,600	2,600	3,600	3,900	3,100	3,900
≥ 25	-	0	2,400	3,600	2,400	3,100	1,900
≥ 50	-	0	0	0	1,800	0	1,800
≥ 100	-	0	0	0	0	0	0

Table 13C-51: Existing Population Counts, L_{den} Metric

Metric Value, dB L_{den}	Scenario and Existing Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	716,725	336,611	351,063	421,417	511,732	217,006	255,392
≥ 50	184,777	77,349	83,696	96,889	130,559	55,979	65,241
≥ 55	35,482	12,850	17,270	19,213	25,976	9,630	12,108
≥ 60	4,717	1,513	2,024	2,006	3,011	1,486	2,201
≥ 65	257	94	142	119	196	71	110
≥ 70	31	13	23	19	32	6	6
≥ 75	6	0	0	0	0	0	0

Table 13C-52: Existing Population Counts, L_{night} Metric

Metric Value, dB L_{night}	Scenario and Existing Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	307,457	138,421	136,626	163,476	268,498	81,373	135,695
≥ 45	55,492	27,964	33,603	33,932	54,532	21,201	28,537
≥ 50	12,316	3,482	5,200	6,080	8,705	3,280	5,357
≥ 55	753	222	356	280	1,059	203	454
≥ 60	56	28	45	31	56	23	38
≥ 65	10	0	0	6	6	0	0
≥ 70	0	0	0	0	0	0	0

Table 13C-53: Existing Population Counts, $L_{Aeq,16h}$ Metric

Metric Value, dB $L_{Aeq,16h}$	Scenario and Existing Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 51	49,110	27,998	28,748	23,699	33,542	18,197	17,119
≥ 54	23,685	10,026	10,416	7,137	13,152	6,220	5,621
≥ 57	9,178	2,185	2,099	2,028	3,139	2,277	2,019
≥ 60	1,999	408	417	298	699	366	295
≥ 63	257	144	147	109	159	109	109
≥ 66	138	58	64	32	79	38	31
≥ 69	28	10	10	0	10	0	0
≥ 72	6	0	0	0	0	0	0

Table 13C-54: Existing Population Counts, $L_{Aeq,8h}$ Metric

Metric Value, dB $L_{Aeq,8h}$	Scenario and Existing Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	68,927	33,756	43,513	37,285	61,460	23,399	31,805
≥ 48	26,963	14,387	14,248	17,094	24,802	9,957	13,190
≥ 51	10,141	2,881	4,831	4,187	6,752	2,553	4,624
≥ 54	2,478	400	1,485	729	1,913	284	1,363
≥ 57	292	167	196	177	287	111	161
≥ 60	113	31	56	31	56	26	41
≥ 63	31	16	23	19	19	6	6
≥ 66	6	0	0	3	3	0	0

Table 13C-55: Existing Population Counts, N65 Metric

Metric Value, N65	Scenario and Existing Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	106,013	45,647	45,796	57,944	55,249	37,722	33,371
≥ 25	69,275	36,920	37,560	38,375	38,020	16,308	15,567
≥ 50	25,560	19,716	20,316	21,663	21,125	7,950	7,372
≥ 100	17,985	5,439	5,682	5,665	6,634	4,389	4,237
≥ 200	11,062	3,341	3,351	3,554	3,547	3,171	3,145
≥ 500	0	0	0	0	0	0	0

Table 13C-56: Existing Population Counts, N60 Metric

Metric Value, N60	Scenario and Existing Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	69,613	41,432	46,401	44,908	56,517	27,353	29,801
≥ 25	24,638	296	8,820	15,333	16,277	12,452	12,981
≥ 50	80	0	67	16	110	16	98
≥ 100	0	0	0	0	0	0	0

Table 13C-57: Existing Population Counts, L_{day} Metric

Metric Value, dB L_{day}	Scenario and Existing Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	365,466	129,505	134,446	206,521	207,820	114,077	100,557
≥ 50	74,812	31,119	32,365	46,140	44,576	23,827	22,057
≥ 55	17,388	4,498	4,709	7,347	7,850	4,452	4,117
≥ 60	1,446	358	361	619	547	295	269
≥ 65	169	79	79	97	109	55	49
≥ 70	19	0	0	0	3	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-58: Existing Population Counts, $L_{evening}$ Metric

Metric Value, dB $L_{evening}$	Scenario and Existing Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	240,109	108,672	111,092	123,458	119,367	75,114	69,817
≥ 50	46,556	25,908	26,370	30,497	28,901	17,082	15,713
≥ 55	8,522	3,511	3,323	4,466	4,185	3,416	2,885
≥ 60	323	247	253	306	282	202	181
≥ 65	31	38	47	61	58	22	16
≥ 70	6	0	0	0	0	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-59: Existing Population Counts, L_{night} East Metric

Metric Value, dB $L_{evening}$	Scenario and Existing Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	-	38,572	56,214	48,992	89,580	27,676	52,057
≥ 45	-	3,882	9,498	7,366	13,806	2,300	3,965
≥ 50	-	238	551	535	869	359	696
≥ 55	-	23	48	42	57	31	45
≥ 60	-	0	13	6	0	0	0
≥ 65	-	0	0	0	0	0	0
≥ 70	-	0	0	0	0	0	0

Table 13C-60: Existing Population Counts, L_{night} West Metric

Metric Value, dB $L_{evening}$	Scenario and Existing Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	-	141,912	124,788	≥187,873*	≥272,558*	82,652	127,326
≥ 45	-	25,179	24,780	30,567	50,125	19,831	25,399
≥ 50	-	4,511	4,708	7,804	9,605	3,635	5,494
≥ 55	-	247	945	311	1,386	220	1,183
≥ 60	-	28	52	41	62	25	38
≥ 65	-	3	0	6	6	0	0
≥ 70	-	0	0	0	0	0	0

* 2025 westerly contours extend beyond the dwelling and population dataset

Table 13C-61: Existing Population Counts, N60 East Metric

Metric Value, dB $L_{evening}$	Scenario and Existing Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	-	83,388	96,695	92,470	131,286	36,478	69,087
≥ 25	-	634	40,178	31,343	29,145	19,875	18,138
≥ 50	-	0	56	21	653	16	282
≥ 100	-	0	0	0	0	0	0

Table 13C-62: Existing Population Counts, N60 West Metric

Metric Value, dB $L_{evening}$	Scenario and Existing Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	-	40,993	33,123	47,243	77,665	21,874	28,414
≥ 25	-	415	14,899	19,380	9,763	15,876	7,011
≥ 50	-	0	67	38	5,802	23	5,786
≥ 100	-	0	0	0	0	0	0

Table 13C-63: Permitted Population Counts, L_{den} Metric

Metric Value, dB L_{den}	Scenario and Permitted Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	22,852	21,030	21,764	22,061	22,323	18,982	20,174
≥ 50	17,791	10,099	10,778	10,925	12,172	9,122	9,812
≥ 55	6,486	5,160	4,556	5,808	6,201	5,160	5,573
≥ 60	3,038	980	1,098	1,098	1,163	1,030	1,098
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-64: Permitted Population Counts, L_{night} Metric

Metric Value, dB L_{night}	Scenario and Permitted Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	18,014	16,347	11,567	17,282	19,709	10,139	12,172
≥ 45	9,385	6,174	7,613	7,192	9,665	6,001	7,330
≥ 50	3,210	3,038	1,504	3,103	3,638	3,038	3,103
≥ 55	197	0	0	0	394	0	0
≥ 60	0	0	0	0	0	0	0
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0

Table 13C-65: Permitted Population Counts, $L_{Aeq,16h}$ Metric

Metric Value, dB $L_{Aeq,16h}$	Scenario and Permitted Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 51	9,114	5,356	5,530	5,307	5,847	4,489	4,192
≥ 54	5,320	2,498	2,498	2,457	3,284	2,375	2,228
≥ 57	3,103	1,098	1,098	1,098	1,163	1,098	1,098
≥ 60	1,897	0	0	0	197	0	0
≥ 63	0	0	0	0	0	0	0
≥ 66	0	0	0	0	0	0	0
≥ 69	0	0	0	0	0	0	0

Table 13C-66: Permitted Population Counts, $L_{Aeq,8h}$ Metric

Metric Value, dB $L_{Aeq,8h}$	Scenario and Permitted Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	9,453	7,124	8,318	8,269	10,078	6,074	7,779
≥ 48	5,958	4,356	5,591	4,438	6,189	3,210	5,160
≥ 51	3,103	2,970	1,397	3,038	3,210	2,619	2,752
≥ 54	1,732	121	1,030	121	1,264	0	980
≥ 57	0	0	0	0	0	0	0
≥ 60	0	0	0	0	0	0	0
≥ 63	0	0	0	0	0	0	0

Table 13C-67: Permitted Population Counts, N65 Metric

Metric Value, N65	Scenario and Permitted Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	15,341	6,923	6,923	8,863	9,172	7,411	7,341
≥ 25	8,189	6,158	6,291	6,291	6,158	3,803	3,803
≥ 50	5,243	3,853	3,889	4,033	4,033	2,498	2,498
≥ 100	3,369	1,163	1,163	1,163	1,259	1,163	1,163
≥ 200	3,103	1,163	1,163	1,163	1,163	1,163	1,163
≥ 500	0	0	0	0	0	0	0

Table 13C-68: Permitted Population Counts, N60 Metric

Metric Value, N60	Scenario and Permitted Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	12,078	7,930	8,272	8,601	8,880	7,348	7,348
≥ 25	5,884	0	3,722	5,500	5,662	4,668	5,160
≥ 50	0	0	0	0	0	0	0
≥ 100	0	0	0	0	0	0	0

Table 13C-69: Permitted Population Counts, L_{day} Metric

Metric Value, dB L_{day}	Scenario and Permitted Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	19,894	10,022	10,174	17,970	18,710	11,915	11,293
≥ 50	9,599	5,847	5,847	7,272	6,746	5,533	5,356
≥ 55	4,356	1,163	1,163	2,416	2,122	1,163	1,163
≥ 60	718	0	0	0	0	0	0
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-70: Permitted Population Counts, $L_{evening}$ Metric

Metric Value, dB $L_{evening}$	Scenario and Permitted Population Count						
	2018	*2022 Permitted*	*2022 Proposed*	*2025 Permitted*	*2025 Proposed*	*2035 Permitted*	*2035 Proposed*
≥ 45	18,089	9,470	9,512	9,860	9,669	8,635	8,557
≥ 50	8,864	5,356	5,307	5,847	5,847	4,324	4,096
≥ 55	3,103	1,163	1,163	1,163	1,163	1,163	1,163
≥ 60	0	0	0	0	0	0	0
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-71: Permitted Population Counts, L_{night} East Metric

Metric Value, dB $L_{evening}$	Scenario and Permitted Population Count						
	2018	*2022 Permitted*	*2022 Proposed*	*2025 Permitted*	*2025 Proposed*	*2035 Permitted*	*2035 Proposed*
≥ 40	-	8,698	10,135	9,597	11,202	7,271	7,865
≥ 45	-	2,619	4,826	3,802	4,251	2,137	1,940
≥ 50	-	0	121	121	234	121	121
≥ 55	-	0	0	0	0	0	0
≥ 60	-	0	0	0	0	0	0
≥ 65	-	0	0	0	0	0	0
≥ 70	-	0	0	0	0	0	0

Table 13C-72: Permitted Population Counts, L_{night} West Metric

Metric Value, dB $L_{evening}$	Scenario and Permitted Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	-	16,036	16,274	16,199	18,187	9,599	16,142
≥ 45	-	5,314	6,902	5,891	8,119	5,727	7,348
≥ 50	-	3,038	1,163	3,103	3,531	3,038	2,689
≥ 55	-	0	591	0	980	0	886
≥ 60	-	0	0	0	0	0	0
≥ 65	-	0	0	0	0	0	0
≥ 70	-	0	0	0	0	0	0

Table 13C-73: Permitted Population Counts, N60 East Metric

Metric Value, dB $L_{evening}$	Scenario and Permitted Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	-	10,345	10,992	10,846	12,090	7,933	9,224
≥ 25	-	0	8,066	7,887	6,023	6,053	5,664
≥ 50	-	0	0	0	0	0	0
≥ 100	-	0	0	0	0	0	0

Table 13C-74: Permitted Population Counts, N60 West Metric

Metric Value, dB $L_{evening}$	Scenario and Permitted Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	-	6,198	4,255	7,295	11,417	5,426	5,928
≥ 25	-	0	3,693	5,766	3,722	4,668	3,114
≥ 50	-	0	0	0	2,619	0	2,619
≥ 100	-	0	0	0	0	0	0

Table 13C-75: Zoned Population Counts, L_{den} Metric

Metric Value, dB L_{den}	Scenario and Zoned Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	13,500	13,500	13,500	13,500	13,500	13,500	13,500
≥ 50	12,600	12,600	12,600	12,600	13,500	12,600	13,500
≥ 55	12,600	10,800	12,300	12,600	12,600	10,500	10,800
≥ 60	7,500	3,300	3,900	3,900	4,200	3,600	3,900
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-76: Zoned Population Counts, L_{night} Metric

Metric Value, dB L_{night}	Scenario and Zoned Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	13,200	12,600	13,500	12,900	13,500	12,600	13,500
≥ 45	12,600	12,600	12,600	12,600	13,500	12,600	12,600
≥ 50	8,400	7,500	8,100	8,100	9,000	7,500	8,100
≥ 55	0	0	0	0	600	0	0
≥ 60	0	0	0	0	0	0	0
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0

Table 13C-77: Zoned Population Counts, $L_{Aeq,16h}$ Metric

Metric Value, dB $L_{Aeq,16h}$	Scenario and Zoned Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 51	12,600	9,000	9,000	9,000	9,000	9,000	9,000
≥ 54	10,500	6,300	6,300	5,700	7,200	5,400	5,400
≥ 57	8,100	3,900	3,900	3,900	4,500	3,900	3,900
≥ 60	3,600	0	0	0	0	0	0
≥ 63	0	0	0	0	0	0	0
≥ 66	0	0	0	0	0	0	0
≥ 69	0	0	0	0	0	0	0

Table 13C-78: Zoned Population Counts, $L_{Aeq,8h}$ Metric

Metric Value, dB $L_{Aeq,8h}$	Scenario and Zoned Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	12,600	12,600	12,600	12,600	13,500	12,600	12,600
≥ 48	10,800	9,300	12,600	10,500	12,600	9,000	10,500
≥ 51	8,100	7,500	6,900	7,500	8,400	7,500	8,100
≥ 54	5,100	0	3,300	300	4,500	0	3,300
≥ 57	0	0	0	0	0	0	0
≥ 60	0	0	0	0	0	0	0
≥ 63	0	0	0	0	0	0	0

Table 13C-79: Zoned Population Counts, N65 Metric

Metric Value, N65	Scenario and Zoned Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	12,600	9,000	9,000	12,600	12,600	12,600	12,600
≥ 25	12,600	9,000	9,000	9,000	9,000	9,000	9,000
≥ 50	10,500	9,000	9,000	9,000	9,000	6,900	6,900
≥ 100	8,100	4,500	4,500	4,500	4,500	4,500	4,500
≥ 200	8,100	4,500	4,500	4,500	4,500	3,900	3,900
≥ 500	0	0	0	0	0	0	0

Table 13C-80: Zoned Population Counts, N60 Metric

Metric Value, N60	Scenario and Zoned Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	12,600	12,600	12,600	12,600	12,600	12,600	12,600
≥ 25	10,800	0	7,200	10,800	10,800	9,300	9,300
≥ 50	0	0	0	0	0	0	0
≥ 100	0	0	0	0	0	0	0

Table 13C-81: Zoned Population Counts, L_{day} Metric

Metric Value, dB L_{day}	Scenario and Zoned Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	13,500	9,900	9,900	13,500	13,500	13,500	13,500
≥ 50	12,600	9,000	9,000	9,300	9,000	9,000	9,000
≥ 55	9,300	4,500	4,500	5,400	5,400	4,800	4,500
≥ 60	2,400	0	0	0	0	0	0
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-82: Zoned Population Counts, $L_{evening}$ Metric

Metric Value, dB $L_{evening}$	Scenario and Zoned Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	13,500	9,600	9,600	10,200	10,200	9,000	9,000
≥ 50	12,600	9,000	9,000	9,000	9,000	9,000	9,000
≥ 55	8,100	4,500	4,500	4,800	4,500	4,500	4,200
≥ 60	0	0	0	0	0	0	0
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-83: Zoned Population Counts, L_{night} East Metric

Metric Value, dB $L_{evening}$	Scenario and Zoned Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	-	12,600	12,600	12,600	13,500	12,600	13,500
≥ 45	-	7,800	12,000	10,500	10,500	4,200	4,200
≥ 50	-	0	900	1,200	2,400	0	2,400
≥ 55	-	0	0	0	0	0	0
≥ 60	-	0	0	0	0	0	0
≥ 65	-	0	0	0	0	0	0
≥ 70	-	0	0	0	0	0	0

Table 13C-84: Zoned Population Counts, L_{night} West Metric

Metric Value, dB $L_{evening}$	Scenario and Zoned Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	-	12,600	12,600	12,600	12,900	12,600	12,600
≥ 45	-	9,300	12,600	10,800	12,600	10,500	12,600
≥ 50	-	7,500	4,500	7,500	8,400	7,500	6,900
≥ 55	-	0	900	0	3,300	0	3,000
≥ 60	-	0	0	0	0	0	0
≥ 65	-	0	0	0	0	0	0
≥ 70	-	0	0	0	0	0	0

Table 13C-85: Zoned Population Counts, N60 East Metric

Metric Value, dB $L_{evening}$	Scenario and Zoned Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	-	13,500	13,500	13,500	13,500	12,600	13,500
≥ 25	-	0	12,600	12,600	13,500	12,600	12,600
≥ 50	-	0	0	0	0	0	0
≥ 100	-	0	0	0	0	0	0

Table 13C-86: Zoned Population Counts, N60 West Metric

Metric Value, dB $L_{evening}$	Scenario and Zoned Population Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	-	10,800	7,800	10,800	11,700	9,300	11,700
≥ 25	-	0	7,200	10,800	7,200	9,300	5,700
≥ 50	-	0	0	0	5,400	0	5,400
≥ 100	-	0	0	0	0	0	0

Community Building Counts

13C.4.4 For each assessment scenario and metric, the tables below present the number of community buildings within each contour. The following community buildings have been assessed:

- Education Buildings
- Residential Healthcare Facilities
- Religious Buildings

13C.4.5 Not all metrics will be relevant for all receptors, e.g. education buildings are not typically noise-sensitive at night, however full results have been presented for completeness.

13C.4.6 All of the counts below are cumulative, i.e. the buildings within a 60 dB contour would also be counted as within the corresponding 50 dB contour. Table 13C-87 provides a reference to aid finding a specific result.

Table 13C-87: Community Building Count Table References

Metric	*Result Item and Table Reference*		
	Education Buildings	**Residential Healthcare Facilities**	**Religious Buildings**
L_{den}	Table 13C-88	Table 13C-100	Table 13C-112
L_{night}	Table 13C-89	Table 13C-101	Table 13C-113
$L_{Aeq,16h}$	Table 13C-90	Table 13C-102	Table 13C-114
$L_{Aeq,8h}$	Table 13C-91	Table 13C-103	Table 13C-115
N65	Table 13C-92	Table 13C-104	Table 13C-116
N60	Table 13C-93	Table 13C-105	Table 13C-117
L_{day}	Table 13C-94	Table 13C-106	Table 13C-118
$L_{evening}$	Table 13C-95	Table 13C-107	Table 13C-119
L_{night} East	Table 13C-96	Table 13C-108	Table 13C-120
L_{night} West	Table 13C-97	Table 13C-109	Table 13C-121
N60 East	Table 13C-98	Table 13C-110	Table 13C-122
N60 West	Table 13C-99	Table 13C-111	Table 13C-123

Table 13C-88: Education Building Counts, L_{den} Metric

Metric Value, dB L_{den}	Scenario and Education Building Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	336	128	126	172	202	77	93
≥ 50	62	21	23	31	40	11	15
≥ 55	10	5	7	7	8	5	6
≥ 60	2	1	2	2	2	1	2
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-89: Education Building Counts, L_{night} Metric

Metric Value, dB L_{night}	Scenario and Education Building Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	117	42	43	50	98	26	40
≥ 45	15	9	10	9	10	7	7
≥ 50	3	2	3	2	4	2	3
≥ 55	1	0	0	0	1	0	0
≥ 60	0	0	0	0	0	0	0
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0

Table 13C-90: Education Building Counts, $L_{Aeq,16h}$ Metric

Metric Value, dB $L_{Aeq,16h}$	Scenario and Education Building Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 51	9	10	10	10	10	10	10
≥ 54	8	6	6	5	6	5	4
≥ 57	2	2	2	2	2	2	2
≥ 60	1	1	1	0	1	0	0
≥ 63	1	0	0	0	0	0	0
≥ 66	0	0	0	0	0	0	0
≥ 69	0	0	0	0	0	0	0

Table 13C-91: Education Building Counts, $L_{Aeq,8h}$ Metric

Metric Value, dB $L_{Aeq,8h}$	Scenario and Education Building Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	18	9	10	9	11	7	7
≥ 48	11	4	7	5	7	3	6
≥ 51	3	1	3	2	3	1	2
≥ 54	1	1	1	1	1	0	0
≥ 57	0	0	0	0	0	0	0
≥ 60	0	0	0	0	0	0	0
≥ 63	0	0	0	0	0	0	0

Table 13C-92: Education Building Counts, N65 Metric

Metric Value, N65	Scenario and Education Building Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	30	16	16	16	16	11	11
≥ 25	21	12	12	12	12	8	8
≥ 50	8	8	8	9	8	7	7
≥ 100	5	2	2	3	2	2	2
≥ 200	2	2	2	2	2	2	2
≥ 500	0	0	0	0	0	0	0

Table 13C-93: Education Building Counts, N60 Metric

Metric Value, N60	Scenario and Education Building Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	22	9	11	9	11	9	9
≥ 25	9	1	6	6	7	5	6
≥ 50	0	0	0	0	0	0	0
≥ 100	0	0	0	0	0	0	0

Table 13C-94: Education Building Counts, L_{day} Metric

Metric Value, dB L_{day}	Scenario and Education Building Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	149	48	52	79	79	33	30
≥ 50	21	10	10	13	13	10	10
≥ 55	6	2	2	5	5	3	3
≥ 60	1	0	0	1	1	0	0
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-95: Education Building Counts, $L_{evening}$ Metric

Metric Value, dB $L_{evening}$	Scenario and Education Building Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	83	35	38	44	42	25	24
≥ 50	10	10	10	10	10	10	10
≥ 55	2	2	2	3	2	2	2
≥ 60	1	0	0	0	0	0	0
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-96: Education Building Counts, L_{night} East Metric

Metric Value, dB $L_{evening}$	*Scenario and Education Building Count*						
	2018	*2022 Permitted*	*2022 Proposed*	*2025 Permitted*	*2025 Proposed*	*2035 Permitted*	*2035 Proposed*
≥ 40	-	9	15	13	23	6	12
≥ 45	-	2	5	3	4	1	1
≥ 50	-	0	0	0	0	0	0
≥ 55	-	0	0	0	0	0	0
≥ 60	-	0	0	0	0	0	0
≥ 65	-	0	0	0	0	0	0
≥ 70	-	0	0	0	0	0	0

Table 13C-97: Education Building Counts, L_{night} West Metric

Metric Value, dB $L_{evening}$	*Scenario and Education Building Count*						
	2018	*2022 Permitted*	*2022 Proposed*	*2025 Permitted*	*2025 Proposed*	*2035 Permitted*	*2035 Proposed*
≥ 40	-	46	41	≥64*	≥101*	23	42
≥ 45	-	8	9	9	13	7	7
≥ 50	-	1	2	2	4	2	3
≥ 55	-	0	0	1	1	0	0
≥ 60	-	0	0	0	0	0	0
≥ 65	-	0	0	0	0	0	0
≥ 70	-	0	0	0	0	0	0

* 2025 westerly contours extend beyond the community building dataset

Table 13C-98: Education Building Counts, N60 East Metric

Metric Value, dB $L_{evening}$	*Scenario and Education Building Count*						
	2018	*2022 Permitted*	*2022 Proposed*	*2025 Permitted*	*2025 Proposed*	*2035 Permitted*	*2035 Proposed*
≥ 10	-	23	30	27	39	8	16
≥ 25	-	1	11	6	8	5	6
≥ 50	-	0	0	0	0	0	0
≥ 100	-	0	0	0	0	0	0

Table 13C-99: Education Building Counts, N60 West Metric

Metric Value, dB $L_{evening}$	Scenario and Education Building Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	-	10	15	11	23	9	11
≥ 25	-	1	7	7	6	5	6
≥ 50	-	0	0	0	4	0	4
≥ 100	-	0	0	0	0	0	0

Table 13C-100: Residential Healthcare Facility Counts, L_{den} Metric

Metric Value, dB L_{den}	Scenario and Residential Healthcare Facility Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	28	8	9	10	13	8	9
≥ 50	6	2	2	3	4	2	2
≥ 55	2	1	1	2	2	1	1
≥ 60	1	1	1	1	1	1	1
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-101: Residential Healthcare Facility Counts, L_{night} Metric

Metric Value, dB L_{night}	Scenario and Residential Healthcare Facility Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	10	4	4	5	8	3	5
≥ 45	4	2	2	2	2	1	1
≥ 50	1	1	1	1	1	1	1
≥ 55	1	0	1	0	1	0	1
≥ 60	0	0	0	0	0	0	0
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0

Table 13C-102: Residential Healthcare Facility Counts, $L_{Aeq,16h}$ Metric

Metric Value, dB $L_{Aeq,16h}$	Scenario and Residential Healthcare Facility Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 51	2	2	2	2	2	1	1
≥ 54	2	1	1	1	1	1	1
≥ 57	1	1	1	1	1	1	1
≥ 60	1	0	0	0	1	1	0
≥ 63	0	0	0	0	0	0	0
≥ 66	0	0	0	0	0	0	0
≥ 69	0	0	0	0	0	0	0

Table 13C-103: Residential Healthcare Facility Counts, $L_{Aeq,8h}$ Metric

Metric Value, dB $L_{Aeq,8h}$	Scenario and Residential Healthcare Facility Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	3	2	2	2	2	1	1
≥ 48	2	1	1	1	1	1	1
≥ 51	1	1	1	1	1	1	1
≥ 54	1	0	1	1	1	0	1
≥ 57	0	0	0	0	0	0	0
≥ 60	0	0	0	0	0	0	0
≥ 63	0	0	0	0	0	0	0

Table 13C-104: Residential Healthcare Facility Counts, N65 Metric

Metric Value, N65	Scenario and Residential Healthcare Facility Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	3	3	3	3	3	2	2
≥ 25	2	2	2	2	2	1	1
≥ 50	1	1	1	1	1	1	1
≥ 100	1	1	1	1	1	1	1
≥ 200	1	1	1	1	1	1	1
≥ 500	0	0	0	0	0	0	0

Table 13C-105: Residential Healthcare Facility Counts, N60 Metric

Metric Value, N60	***Scenario and Residential Healthcare Facility Count***						
	2018	*2022 Permitted*	*2022 Proposed*	*2025 Permitted*	*2025 Proposed*	*2035 Permitted*	*2035 Proposed*
≥ 10	3	2	2	2	2	1	1
≥ 25	1	0	1	1	1	1	1
≥ 50	0	0	0	0	0	0	0
≥ 100	0	0	0	0	0	0	0

Table 13C-106: Residential Healthcare Facility Counts, L_{day} Metric

Metric Value, dB L_{day}	***Scenario and Residential Healthcare Facility Count***						
	2018	*2022 Permitted*	*2022 Proposed*	*2025 Permitted*	*2025 Proposed*	*2035 Permitted*	*2035 Proposed*
≥ 45	11	6	6	6	7	4	4
≥ 50	3	2	2	2	2	1	1
≥ 55	2	1	1	1	1	1	1
≥ 60	1	0	0	1	1	0	0
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-107: Residential Healthcare Facility Counts, $L_{evening}$ Metric

Metric Value, dB $L_{evening}$	***Scenario and Residential Healthcare Facility Count***						
	2018	*2022 Permitted*	*2022 Proposed*	*2025 Permitted*	*2025 Proposed*	*2035 Permitted*	*2035 Proposed*
≥ 45	7	5	5	5	5	3	2
≥ 50	2	2	2	2	2	1	1
≥ 55	1	1	1	1	1	1	1
≥ 60	0	0	0	0	0	0	0
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-108: Residential Healthcare Facility Counts, L_{night} East Metric

Metric Value, dB $L_{evening}$	Scenario and Residential Healthcare Facility Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	-	2	2	2	2	2	2
≥ 45	-	1	1	1	1	1	1
≥ 50	-	0	0	0	0	0	0
≥ 55	-	0	0	0	0	0	0
≥ 60	-	0	0	0	0	0	0
≥ 65	-	0	0	0	0	0	0
≥ 70	-	0	0	0	0	0	0

Table 13C-109: Residential Healthcare Facility Counts, L_{night} West Metric

Metric Value, dB $L_{evening}$	Scenario and Residential Healthcare Facility Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	-	5	3	≥5*	≥7*	2	4
≥ 45	-	1	1	2	2	1	1
≥ 50	-	1	1	1	1	1	1
≥ 55	-	0	1	0	1	0	1
≥ 60	-	0	0	0	0	0	0
≥ 65	-	0	0	0	0	0	0
≥ 70	-	0	0	0	0	0	0

* 2025 westerly contours extend beyond the community building dataset

Table 13C-110: Residential Healthcare Facility Counts, N60 East Metric

Metric Value, dB $L_{evening}$	Scenario and Residential Healthcare Facility Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	-	4	5	4	5	3	3
≥ 25	-	0	2	2	2	1	1
≥ 50	-	0	0	0	0	0	0
≥ 100	-	0	0	0	0	0	0

Table 13C-111: Residential Healthcare Facility Counts, N60 West Metric

Metric Value, dB $L_{evening}$	Scenario and Residential Healthcare Facility Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	-	2	1	2	3	1	1
≥ 25	-	0	1	1	1	1	1
≥ 50	-	0	0	0	1	0	1
≥ 100	-	0	0	0	0	0	0

Table 13C-112: Religious Building Counts, L_{den} Metric

Metric Value, dB L_{den}	Scenario and Religious Building Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	116	51	53	67	80	33	42
≥ 50	25	9	11	16	18	7	8
≥ 55	6	4	4	5	5	4	5
≥ 60	3	2	2	2	2	2	2
≥ 65	1	0	0	0	1	0	0
≥ 70	0	0	0	0	0	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-113: Religious Building Counts, L_{night} Metric

Metric Value, dB L_{night}	Scenario and Religious Building Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	46	17	20	21	42	11	17
≥ 45	10	6	6	6	6	5	5
≥ 50	3	2	2	3	3	2	2
≥ 55	2	0	1	1	2	0	1
≥ 60	0	0	0	0	0	0	0
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0

Table 13C-114: Religious Building Counts, $L_{Aeq,16h}$ Metric

Metric Value, dB $L_{Aeq,16h}$	Scenario and Religious Building Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 51	6	5	5	5	5	4	4
≥ 54	5	2	2	2	3	2	2
≥ 57	3	2	2	2	2	2	2
≥ 60	2	2	2	1	2	1	1
≥ 63	0	0	0	0	0	0	0
≥ 66	0	0	0	0	0	0	0
≥ 69	0	0	0	0	0	0	0

Table 13C-115: Religious Building Counts, $L_{Aeq,8h}$ Metric

Metric Value, dB $L_{Aeq,8h}$	Scenario and Religious Building Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	9	6	6	6	6	5	5
≥ 48	6	3	5	3	5	3	4
≥ 51	3	2	2	2	3	2	2
≥ 54	2	1	2	2	2	1	1
≥ 57	1	0	1	0	1	0	1
≥ 60	0	0	0	0	0	0	0
≥ 63	0	0	0	0	0	0	0

Table 13C-116: Religious Building Counts, N65 Metric

Metric Value, N65	Scenario and Religious Building Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	12	8	8	9	9	7	7
≥ 25	8	6	6	6	6	6	6
≥ 50	5	5	6	6	6	2	2
≥ 100	4	2	2	2	2	2	2
≥ 200	3	2	2	2	2	2	2
≥ 500	0	0	0	0	0	0	0

Table 13C-117: Religious Building Counts, N60 Metric

Metric Value, N60	Scenario and Religious Building Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	9	6	6	6	6	6	6
≥ 25	5	1	3	4	4	4	4
≥ 50	0	0	0	0	0	0	0
≥ 100	0	0	0	0	0	0	0

Table 13C-118: Religious Building Counts, L_{day} Metric

Metric Value, dB L_{day}	Scenario and Religious Building Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	52	23	23	34	34	15	15
≥ 50	10	5	5	7	7	5	5
≥ 55	3	2	2	2	2	2	2
≥ 60	2	2	2	2	2	1	1
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-119: Religious Building Counts, $L_{evening}$ Metric

Metric Value, dB $L_{evening}$	Scenario and Religious Building Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 45	31	18	18	22	20	12	11
≥ 50	7	5	5	5	5	4	4
≥ 55	3	2	2	2	2	2	2
≥ 60	1	1	1	1	1	1	1
≥ 65	0	0	0	0	0	0	0
≥ 70	0	0	0	0	0	0	0
≥ 75	0	0	0	0	0	0	0

Table 13C-120: Religious Building Counts, L_{night} East Metric

Metric Value, dB $L_{evening}$	Scenario and Religious Building Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	-	6	8	8	10	5	5
≥ 45	-	1	1	1	4	1	2
≥ 50	-	0	0	0	0	0	0
≥ 55	-	0	0	0	0	0	0
≥ 60	-	0	0	0	0	0	0
≥ 65	-	0	0	0	0	0	0
≥ 70	-	0	0	0	0	0	0

Table 13C-121: Religious Building Counts, L_{night} West Metric

Metric Value, dB $L_{evening}$	Scenario and Religious Building Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 40	-	22	16	≥26*	≥40*	12	16
≥ 45	-	5	6	5	6	4	5
≥ 50	-	3	2	3	3	2	2
≥ 55	-	1	2	2	2	1	1
≥ 60	-	0	0	0	0	0	0
≥ 65	-	0	0	0	0	0	0
≥ 70	-	0	0	0	0	0	0

* 2025 westerly contours extend beyond the community building dataset

Table 13C-122: Religious Building Counts, N60 East Metric

Metric Value, dB $L_{evening}$	Scenario and Religious Building Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	-	12	15	14	19	5	7
≥ 25	-	1	6	5	5	4	4
≥ 50	-	0	0	0	0	0	0
≥ 100	-	0	0	0	0	0	0

Table 13C-123: Religious Building Counts, N60 West Metric

Metric Value, dB $L_{evening}$	Scenario and Religious Building Count						
	2018	2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
≥ 10	-	5	6	5	9	5	7
≥ 25	-	1	3	4	4	4	3
≥ 50	-	0	0	0	2	0	2
≥ 100	-	0	0	0	0	0	0

Night-time $L_{Aeq,1h}$ Noise Levels at Representative Locations

13C.4.7 For each assessment scenario the tables below present the hourly $L_{Aeq,1h}$ noise levels at representative locations for the hours during the night (23:00 to 07:00). The locations are described in Chapter 13 and can be seen in Figure 13-4. Table 13C-124 provides a reference to aid finding a specific result.

Table 13C-124: $L_{Aeq,1h}$ Noise Levels Table References

Scenario	Table Reference
2022 Permitted	Table 13C-125
2022 Proposed	Table 13C-126
2025 Permitted	Table 13C-127
2025 Proposed	Table 13C-128
2035 Permitted	Table 13C-129
2035 Proposed	Table 13C-130

Table 13C-125: Noise Levels at Representative Locations ($L_{Aeq,1h}$) – 2022 Permitted Scenario

Ref. No.	Location	Hour and $L_{Aeq,1h}$ Noise Level (dB)							
		23-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07
AR01	Tyrellstown, Toberburr	31	25	23	21	0	40	41	43
AR02	Ridgewood	34	29	27	25	0	37	45	47
AR03	Swords	30	24	23	22	0	37	39	42
AR04	Malahide Castle	31	29	28	26	0	32	39	40
AR05	Portmarnock N	35	34	34	31	0	36	42	43
AR06	Portmarnock S	45	45	44	40	0	45	48	49
AR07	Malahide S	37	36	36	33	0	38	45	46
AR08	St Doolaghs	54	55	54	50	0	56	56	56
AR09	Darndale Park	40	39	38	35	0	40	47	48
AR10	The Baskins	45	45	44	41	0	46	52	53
AR11	Mayeston Hall	38	32	30	28	0	38	52	52
AR12	Kilshane Cross	56	56	56	52	0	57	61	62
AR13	St Margret's	46	36	35	32	0	48	56	58
AR14	Ashbourne	34	13	11	11	0	17	37	43
AR15	Dunboyne	41	41	39	35	0	41	48	48
AR16	Ongar	26	24	24	21	0	25	46	48
AR17	Mount Garrett	48	47	46	42	0	48	54	56
AR18	Beaumont	35	34	33	30	0	36	43	45

Note – noise levels rounded to nearest whole number. Noise level of 0 dB relates to no flights in that hour.

Table 13C-126: Noise Levels at Representative Locations ($L_{Aeq,1h}$) – 2022 Proposed Scenario

Ref. No.	Location	Hour and $L_{Aeq,1h}$ Noise Level (dB)							
		23-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07
AR01	Tyrellstown, Toberburr	33	32	24	22	0	40	39	53
AR02	Ridgewood	36	34	28	26	0	37	43	58
AR03	Swords	29	30	24	23	0	37	37	48
AR04	Malahide Castle	33	32	29	27	0	33	37	43
AR05	Portmarnock N	39	37	35	32	0	38	41	45
AR06	Portmarnock S	49	47	45	42	0	47	49	52
AR07	Malahide S	41	39	37	34	0	40	44	48
AR08	St Doolaghs	59	56	55	52	0	58	58	57
AR09	Darndale Park	44	41	39	37	0	42	46	51
AR10	The Baskins	49	47	45	42	0	48	51	55
AR11	Mayeston Hall	34	39	31	29	0	39	50	51
AR12	Kilshane Cross	36	58	56	53	0	59	61	52
AR13	St Margret's	44	46	36	33	0	48	53	62
AR14	Ashbourne	20	34	12	12	0	18	34	46
AR15	Dunboyne	35	42	40	37	0	43	48	49
AR16	Ongar	24	28	25	23	0	28	40	48
AR17	Mount Garrett	36	50	47	44	0	50	53	45
AR18	Beaumont	38	37	34	31	0	37	42	47

Note – noise levels rounded to nearest whole number. Noise level of 0 dB relates to no flights in that hour.

Table 13C-127: Noise Levels at Representative Locations ($L_{Aeq,1h}$) – 2025 Permitted Scenario

Ref. No.	Location	Hour and $L_{Aeq,1h}$ Noise Level (dB)							
		23-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07
AR01	Tyrellstown, Toberburr	33	32	25	22	0	40	42	44
AR02	Ridgewood	36	34	29	25	0	37	46	48
AR03	Swords	31	30	25	22	0	37	40	42
AR04	Malahide Castle	32	31	30	26	0	33	39	41
AR05	Portmarnock N	37	36	36	31	0	37	42	44
AR06	Portmarnock S	47	45	46	40	0	47	49	50
AR07	Malahide S	39	38	38	33	0	39	45	46
AR08	St Doolaghs	56	55	56	51	0	57	56	56
AR09	Darndale Park	42	41	41	36	0	41	48	49
AR10	The Baskins	47	46	46	41	0	47	52	53
AR11	Mayeston Hall	41	39	32	28	0	39	52	53
AR12	Kilshane Cross	58	57	58	52	0	58	61	62
AR13	St Margret's	48	46	37	32	0	48	57	59
AR14	Ashbourne	37	34	14	12	0	18	37	43
AR15	Dunboyne	43	41	42	35	0	43	49	49
AR16	Ongar	29	27	26	22	0	27	46	49
AR17	Mount Garrett	50	49	48	42	0	49	55	56
AR18	Beaumont	37	36	35	30	0	37	44	46

Note – noise levels rounded to nearest whole number. Noise level of 0 dB relates to no flights in that hour.

Table 13C-128: Noise Levels at Representative Locations ($L_{Aeq,1h}$) – 2025 Proposed Scenario

Ref. No.	Location	Hour and $L_{Aeq,1h}$ Noise Level (dB)							
		23-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07
AR01	Tyrellstown, Toberburr	37	35	26	23	0	41	39	52
AR02	Ridgewood	41	37	30	26	0	38	43	58
AR03	Swords	32	33	26	23	0	37	37	49
AR04	Malahide Castle	34	34	31	28	0	34	38	51
AR05	Portmarnock N	40	38	36	32	0	39	41	51
AR06	Portmarnock S	50	48	47	42	0	49	49	52
AR07	Malahide S	42	41	38	35	0	41	44	55
AR08	St Doolaghs	60	58	57	52	0	59	58	57
AR09	Darndale Park	45	43	41	37	0	43	47	50
AR10	The Baskins	50	49	47	43	0	49	51	56
AR11	Mayeston Hall	36	42	33	29	0	39	50	55
AR12	Kilshane Cross	38	60	58	54	0	60	61	63
AR13	St Margret's	48	49	37	34	0	49	53	62
AR14	Ashbourne	31	38	14	13	0	19	35	46
AR15	Dunboyne	35	44	42	37	0	44	48	50
AR16	Ongar	24	30	26	23	0	29	40	51
AR17	Mount Garrett	37	51	49	44	0	51	54	57
AR18	Beaumont	39	38	36	32	0	38	42	48

Note – noise levels rounded to nearest whole number. Noise level of 0 dB relates to no flights in that hour.

Table 13C-129: Noise Levels at Representative Locations ($L_{Aeq,1h}$) – 2035 Permitted Scenario

Ref. No.	Location	Hour and $L_{Aeq,1h}$ Noise Level (dB)							
		23-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07
AR01	Tyrellstown, Toberburr	33	31	24	22	0	40	40	41
AR02	Ridgewood	35	33	28	25	0	37	44	44
AR03	Swords	31	30	24	22	0	37	38	39
AR04	Malahide Castle	32	31	29	26	0	33	38	37
AR05	Portmarnock N	36	35	35	31	0	37	41	41
AR06	Portmarnock S	46	45	45	40	0	47	47	48
AR07	Malahide S	39	37	37	33	0	39	44	43
AR08	St Doolaghs	55	54	55	51	0	57	55	55
AR09	Darndale Park	41	40	40	36	0	41	46	46
AR10	The Baskins	47	45	45	41	0	47	51	51
AR11	Mayeston Hall	40	39	30	28	0	38	51	50
AR12	Kilshane Cross	58	56	57	52	0	58	60	61
AR13	St Margret's	48	45	36	32	0	48	54	55
AR14	Ashbourne	37	34	13	12	0	18	36	40
AR15	Dunboyne	42	41	41	35	0	43	48	46
AR16	Ongar	28	27	25	22	0	27	43	46
AR17	Mount Garrett	50	48	48	42	0	49	53	54
AR18	Beaumont	37	35	34	30	0	37	42	43

Note – noise levels rounded to nearest whole number. Noise level of 0 dB relates to no flights in that hour.

Table 13C-130: Noise Levels at Representative Locations ($L_{Aeq,1h}$) – 2035 Proposed Scenario

Ref. No.	Location	Hour and $L_{Aeq,1h}$ Noise Level (dB)							
		23-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07
AR01	Tyrellstown, Toberburr	37	34	25	23	0	40	39	49
AR02	Ridgewood	40	36	28	26	0	37	43	56
AR03	Swords	31	33	25	23	0	37	37	47
AR04	Malahide Castle	33	34	30	28	0	34	38	49
AR05	Portmarnock N	39	38	36	32	0	39	41	49
AR06	Portmarnock S	49	47	46	42	0	49	49	49
AR07	Malahide S	41	40	38	35	0	41	44	53
AR08	St Doolaghs	59	57	56	52	0	59	58	55
AR09	Darndale Park	44	42	40	37	0	43	47	47
AR10	The Baskins	50	48	46	43	0	49	51	53
AR11	Mayeston Hall	34	41	31	29	0	39	50	50
AR12	Kilshane Cross	38	59	57	54	0	60	61	60
AR13	St Margret's	48	49	37	34	0	49	53	59
AR14	Ashbourne	31	38	14	13	0	19	33	44
AR15	Dunboyne	34	43	41	37	0	44	48	47
AR16	Ongar	24	30	26	23	0	29	40	48
AR17	Mount Garrett	36	51	48	44	0	51	53	55
AR18	Beaumont	38	38	35	32	0	38	42	45

Note – noise levels rounded to nearest whole number. Noise level of 0 dB relates to no flights in that hour.

L_{Amax} Noise Levels at Representative Locations

13C.4.8 L_{Amax} footprints for the most common aircraft types have been produced to give an indication of how noise levels will reduce as the modernised aircraft types become more common. Table 13C-131 provides a reference to aid finding a specific figure. Separately, the L_{Amax} noise levels which occur at least once per night at representative locations have been presented in Table 13C-132. The locations are described in Chapter 13 and can be seen in Figure 13-4.

Table 13C-131: L_{Amax} Noise Levels References

Scenario	*Figure Reference*
A320ceo Runway 27L Arrival	13C-81
A320ceo Runway 27L Departure	13C-82
A320neo Runway 27L Arrival	13C-83
A320neo Runway 27L Departure	13C-84
B738 Runway 27L Arrival	13C-85
B738 Runway 27L Departure	13C-86
B737 MAX 8 Runway 27L Arrival	13C-87
B737 MAX 8 Runway 27L Departure	13C-88

Table 13C-132: L_{Amax} noise levels

Ref. No.	Location	L_{Amax} Noise Level (dB) Exceeded Once Per Night					
		2022 Permitted	2022 Proposed	2025 Permitted	2025 Proposed	2035 Permitted	2035 Proposed
AR01	Tyrellstown, Toberburr	59	65	59	65	59	65
AR02	Ridgewood	61	70	61	74	59	70
AR03	Swords	54	59	54	64	54	58
AR04	Malahide Castle	54	54	54	69	53	66
AR05	Portmarnock N	60	60	60	70	59	67
AR06	Portmarnock S	69	69	69	68	67	66
AR07	Malahide S	63	63	63	75	62	72
AR08	St Doolaghs	81	81	81	81	81	81
AR09	Darndale Park	67	67	67	67	65	62
AR10	The Baskins	72	73	72	72	71	68
AR11	Mayeston Hall	67	65	67	67	66	65
AR12	Kilshane Cross	86	86	86	86	86	84
AR13	St Margret's	76	77	76	76	76	76
AR14	Ashbourne	59	61	59	62	58	58
AR15	Dunboyne	67	67	67	67	67	67
AR16	Ongar	66	63	66	66	64	63
AR17	Mount Garrett	74	72	74	74	73	72
AR18	Beaumont	57	57	57	57	55	53

Note – noise levels rounded to nearest whole number.

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LEGEND:

- 10 - 24 N60
- 25 - 49 N60
- 50+ N60

Rev	Date	Description	Initials

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Forecast N60 Noise Contours (Easterly)
2035 Proposed Scenario
Figure 13C-79

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DATE: July 2021 | SCALE: 1:250000@A4

Drawing No:

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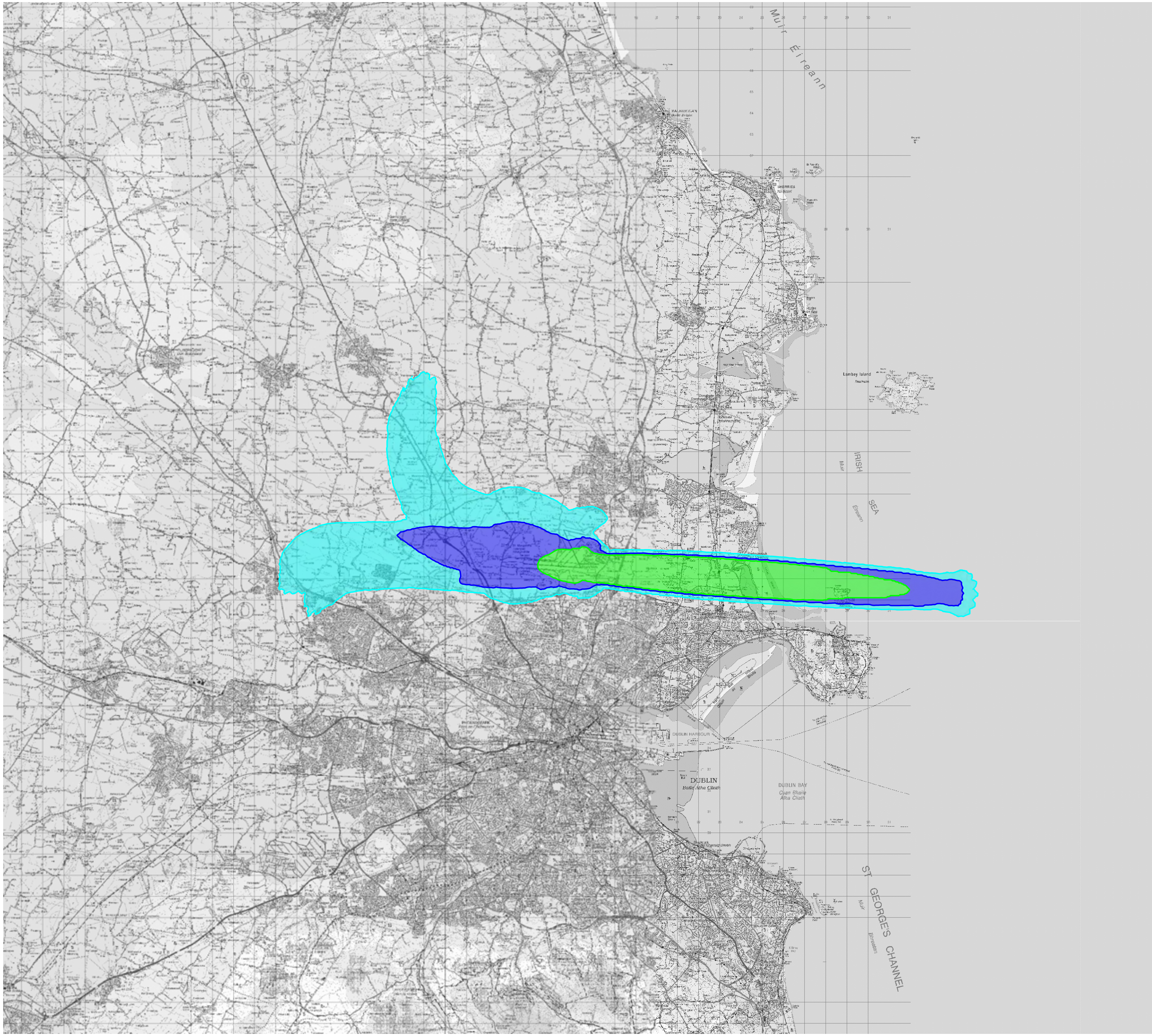

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LEGEND:

10 - 24 N60

25 - 49 N60

50+ N60

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Forecast N60 Noise Contours (Westerly)
2035 Proposed Scenario
Figure 13C-80

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DATE: July 2021 SCALE: 1:250000@A4

Drawing No:

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LEGEND:

- 70 dB L_{Amax}
- 75 dB L_{Amax}
- 80 dB L_{Amax}

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2	Aug 21	Updated title block	MP
3	Sep 21	Updated title block	MP

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LAmax Noise Contours
A320ceo Runway 28L Arrivals
Figure 13C-81

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DATE: July 2021
SCALE: 1:100000@A4

Drawing No:
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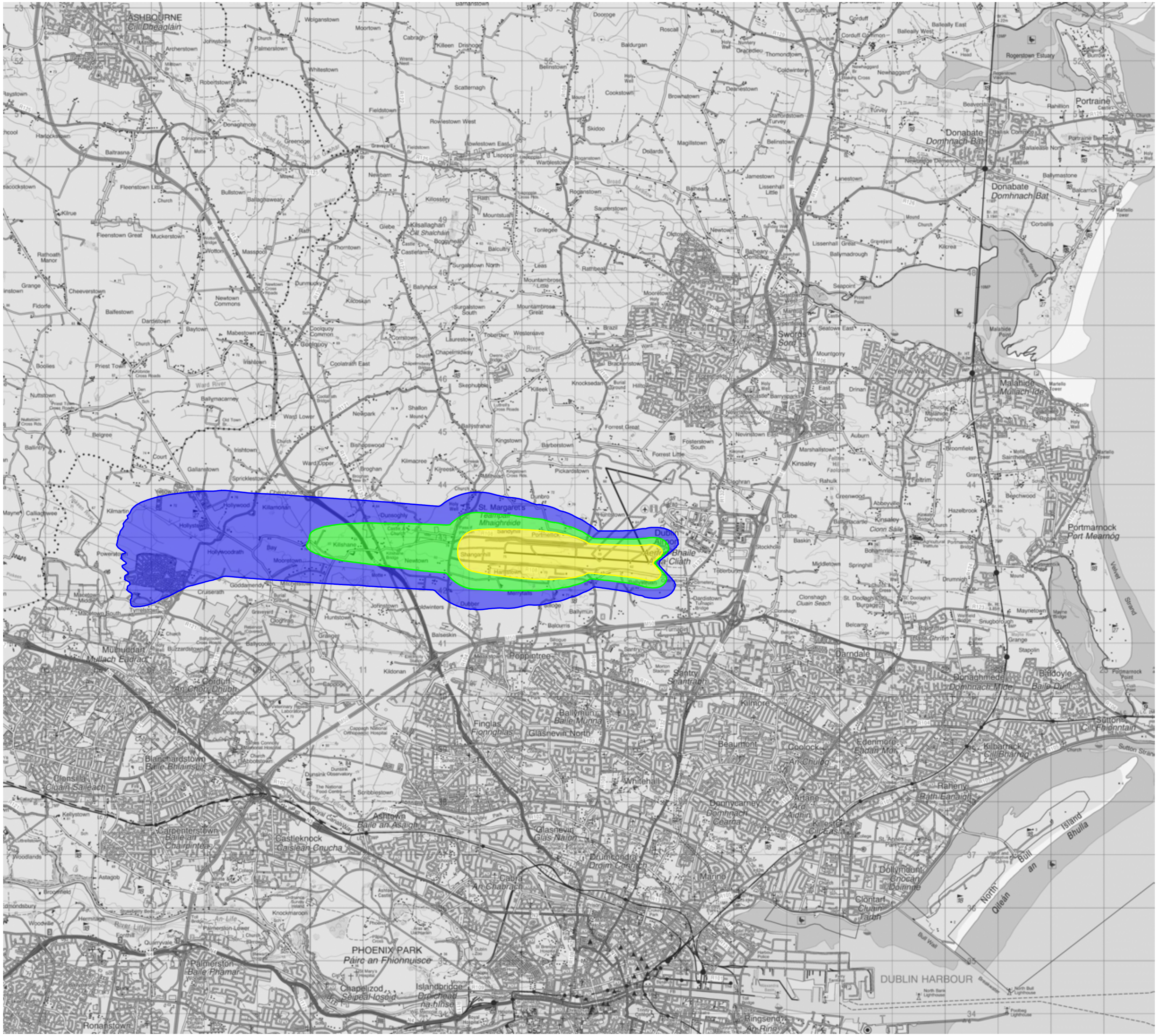

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LEGEND:

- 70 dB L_{Amax}
- 75 dB L_{Amax}
- 80 dB L_{Amax}

Rev	Date	Description	Initials
2	Aug 21	Updated title block	MP
3	Sep 21	Updated title block	MP

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LAmax Noise Contours
A320ceo Runway 28L Departures
Figure 13C-82

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Drawing No:

A11267_19_DR812_3.0

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LEGEND:

- 70 dB L_{Amax}
- 75 dB L_{Amax}
- 80 dB L_{Amax}

Rev	Date	Description	Initials
2	Aug 21	Updated title block	MP
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LAmax Noise Contours
A320neo Runway 28L Arrivals
Figure 13C-83

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DATE: July 2021

SCALE: 1:100000@A4

Drawing No:

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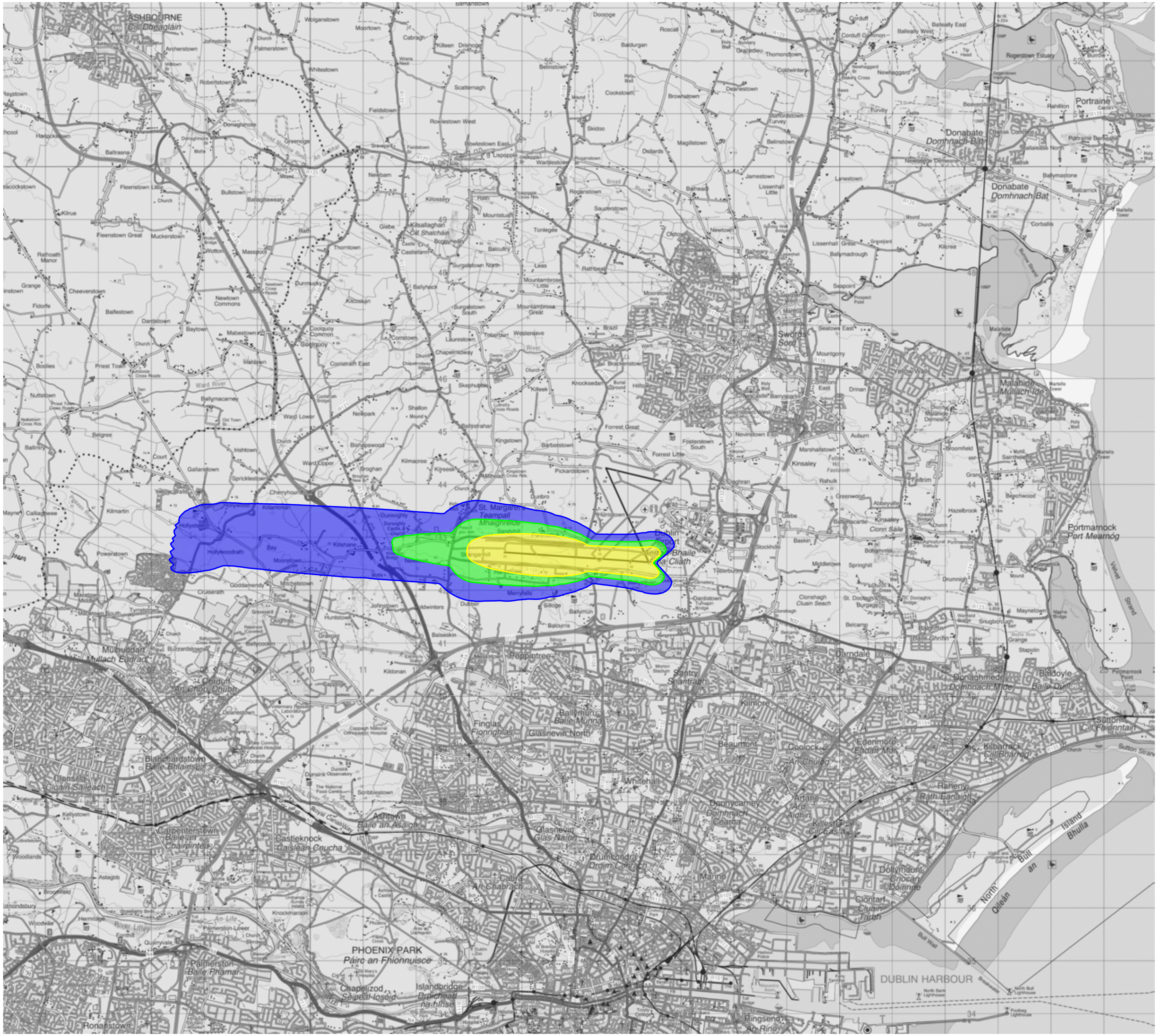

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LEGEND:

- 70 dB L_{Amax}
- 75 dB L_{Amax}
- 80 dB L_{Amax}

Rev	Date	Description	Initials
2	Aug 21	Updated title block	MP
3	Sep 21	Updated title block	MP

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LAmax Noise Contours
A320neo Runway 28L Departures
Figure 13C-84

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Drawing No:

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LEGEND:

- 70 dB L_{Amax}
- 75 dB L_{Amax}
- 80 dB L_{Amax}

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2	Aug 21	Updated title block	MP
3	Sep 21	Updated title block	MP

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LAmax Noise Contours
B738 Runway 28L Arrivals
Figure 13C-85

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DATE: July 2021 SCALE: 1:100000@A4

Drawing No:

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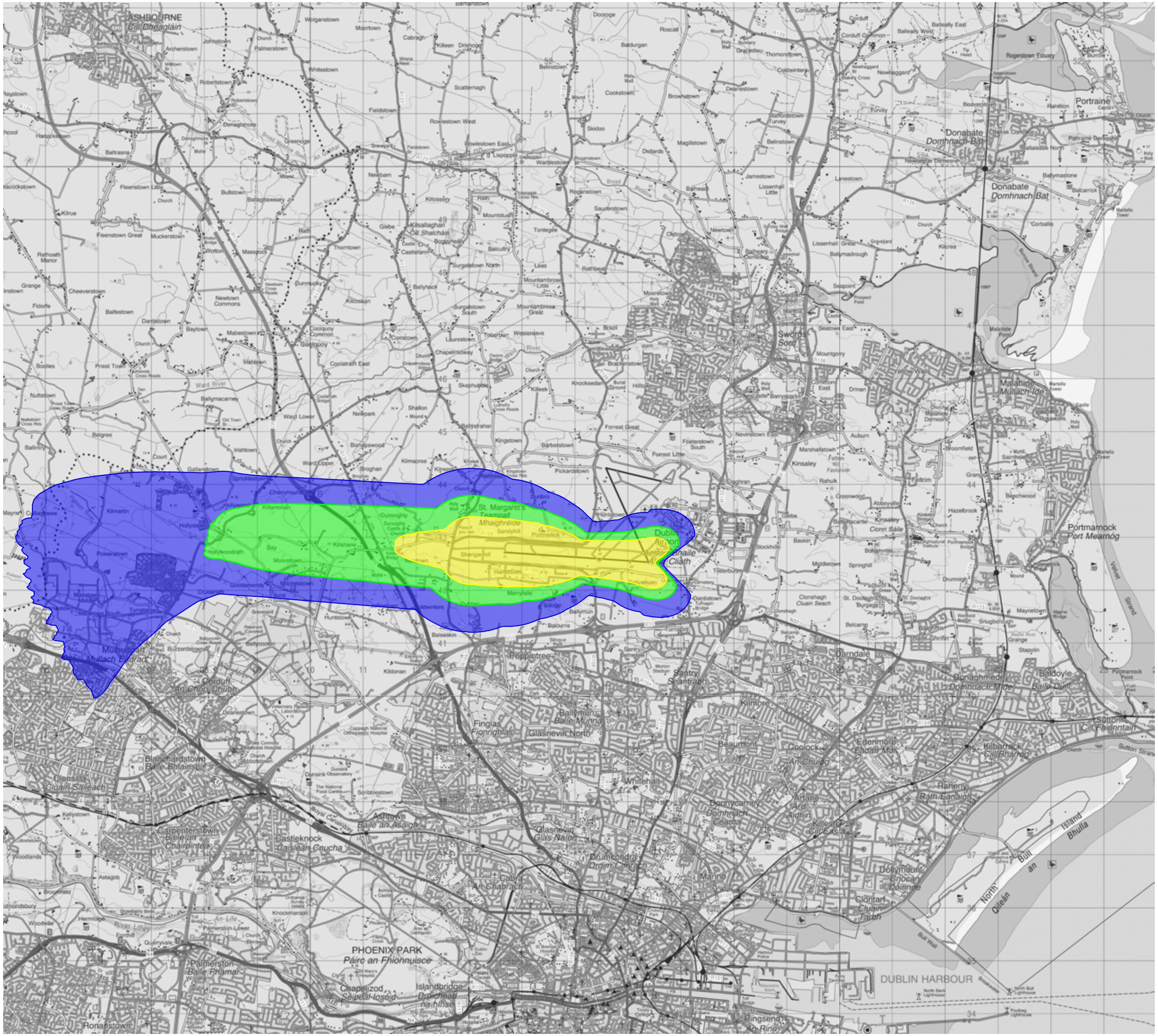

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LEGEND:

- 70 dB L_{Amax}
- 75 dB L_{Amax}
- 80 dB L_{Amax}

Rev	Date	Description	Initials
2	Aug 21	Updated title block	MP
3	Sep 21	Updated title block	MP

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LAmax Noise Contours
B738 Runway 28L Departures
Figure 13C-86

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Drawing No:

A11267_19_DR816_3.0

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LEGEND:

- 70 dB L_{Amax}
- 75 dB L_{Amax}
- 80 dB L_{Amax}

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2	Aug 21	Updated title block	MP
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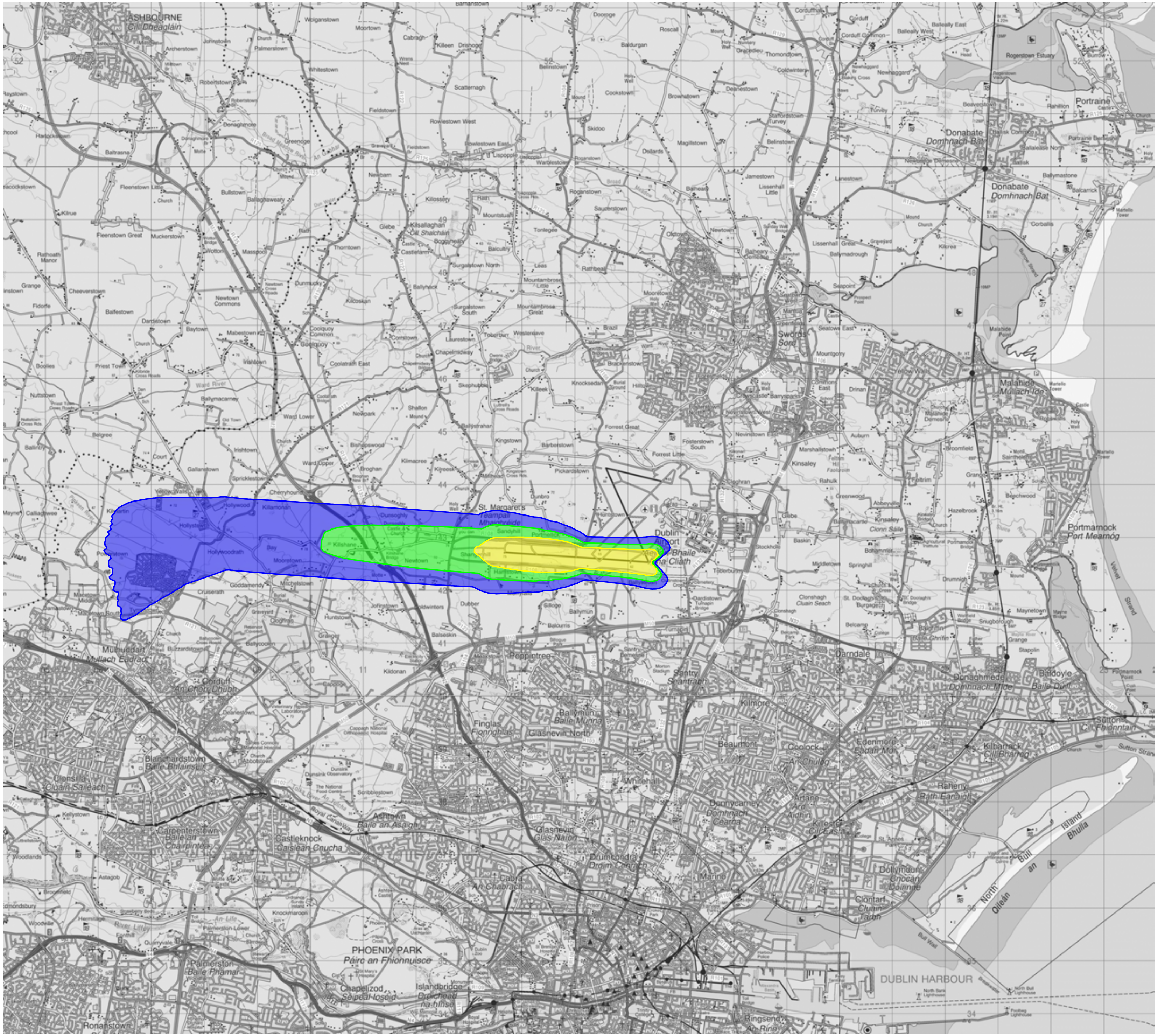
LAmax Noise Contours
B737 MAX 8 Runway 28L Arrivals
Figure 13C-87

DRAWN: MP CHECKED: DC

DATE: July 2021 SCALE: 1:100000@A4

Drawing No:

A11267_19_DR817_3.0



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LEGEND:

- 70 dB L_{Amax}
- 75 dB L_{Amax}
- 80 dB L_{Amax}

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B737 MAX 8 Runway 28L Departures
Figure 13C-88

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Drawing No:

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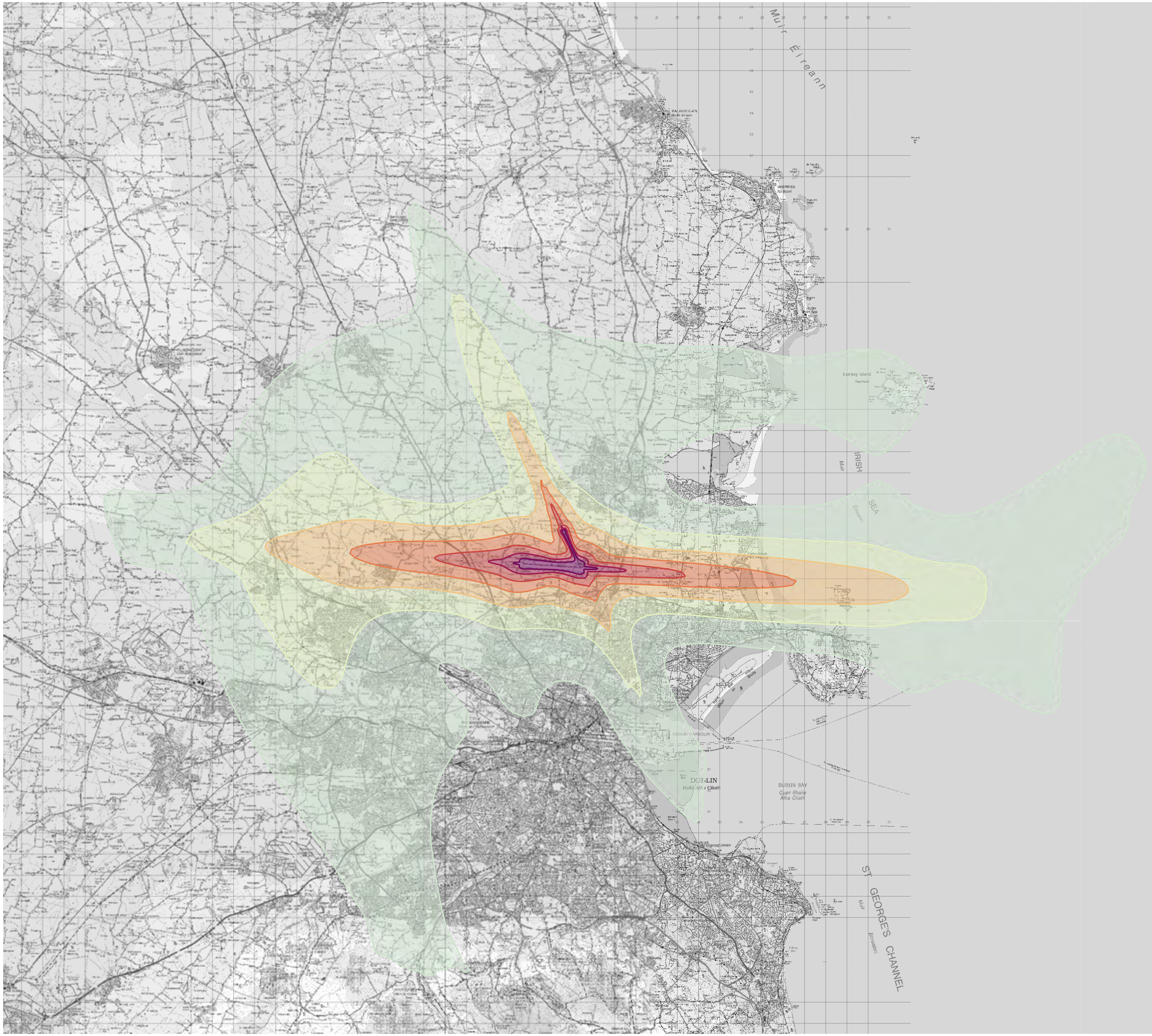

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LEGEND:

- 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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Actual Lden Noise Contours
2018
Figure 13C-1

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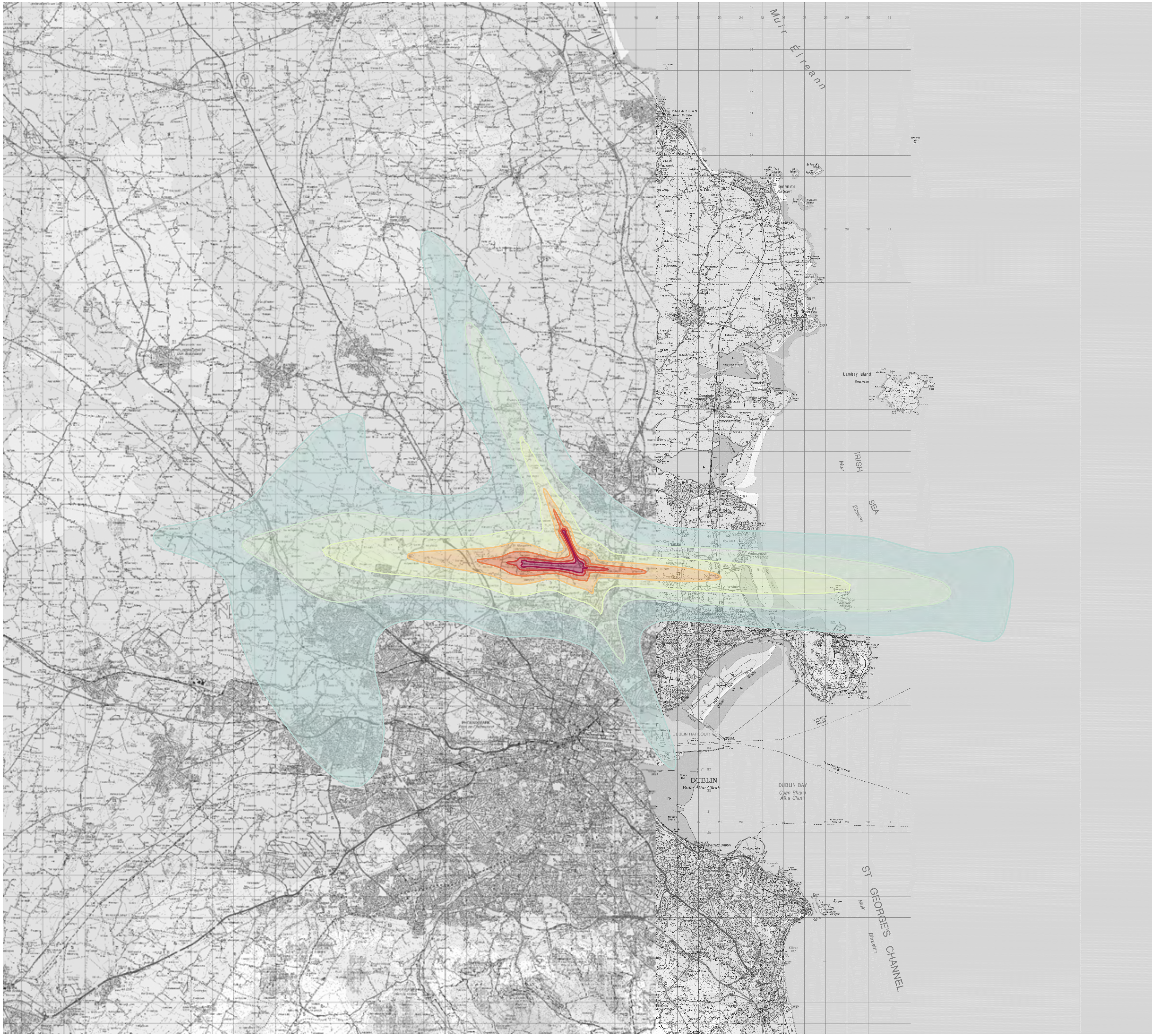
DATE: July 2021 SCALE: 1:250000@A4

Drawing No:

A11267_19_DR690_2.0



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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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Actual Lnight Noise Contours
2018
Figure 13C-2

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DATE: July 2021 SCALE: 1:250000@A4

Drawing No:

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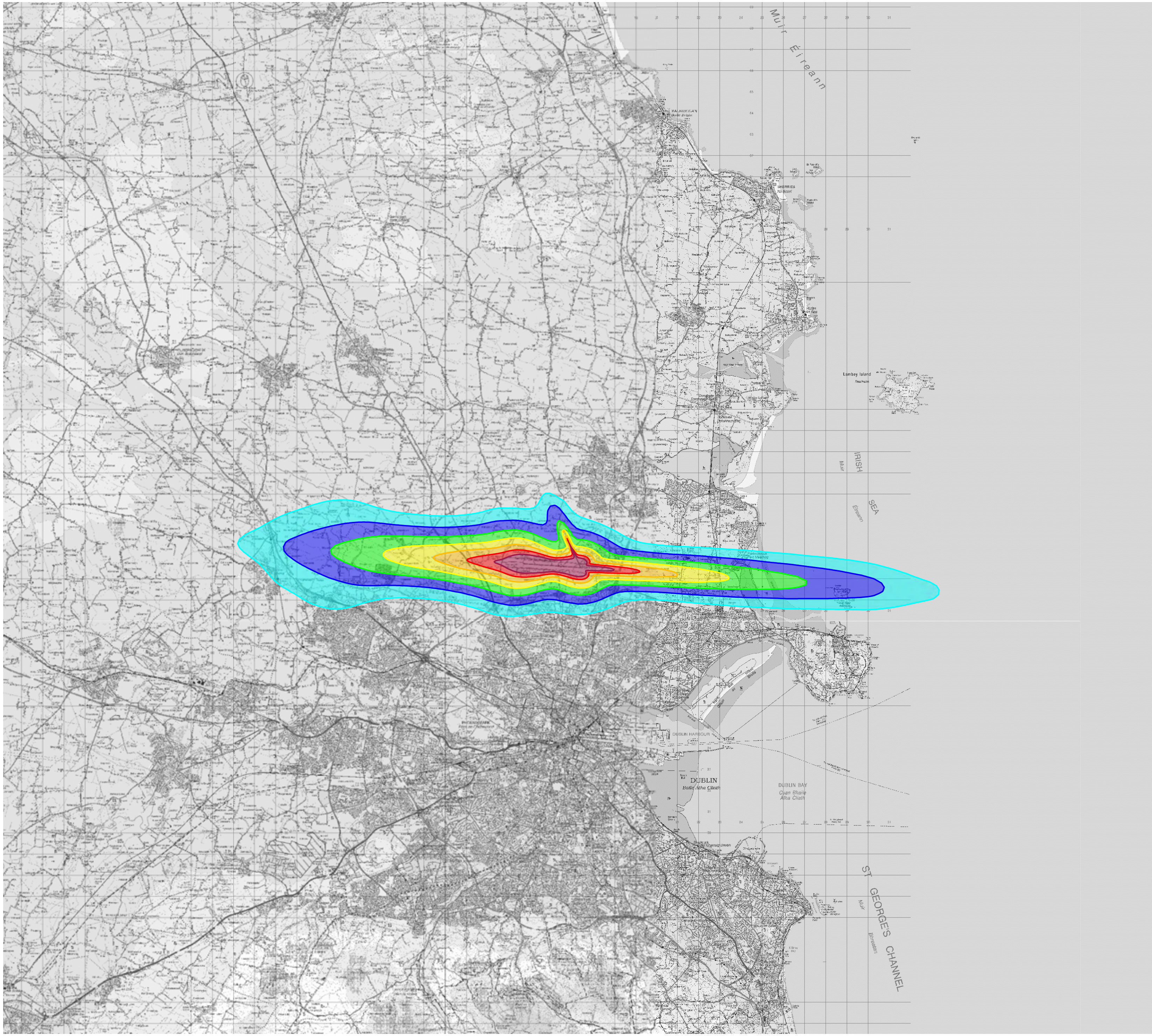

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LEGEND:

- 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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Actual LAeq,16h Noise Contours
2018
Figure 13C-3

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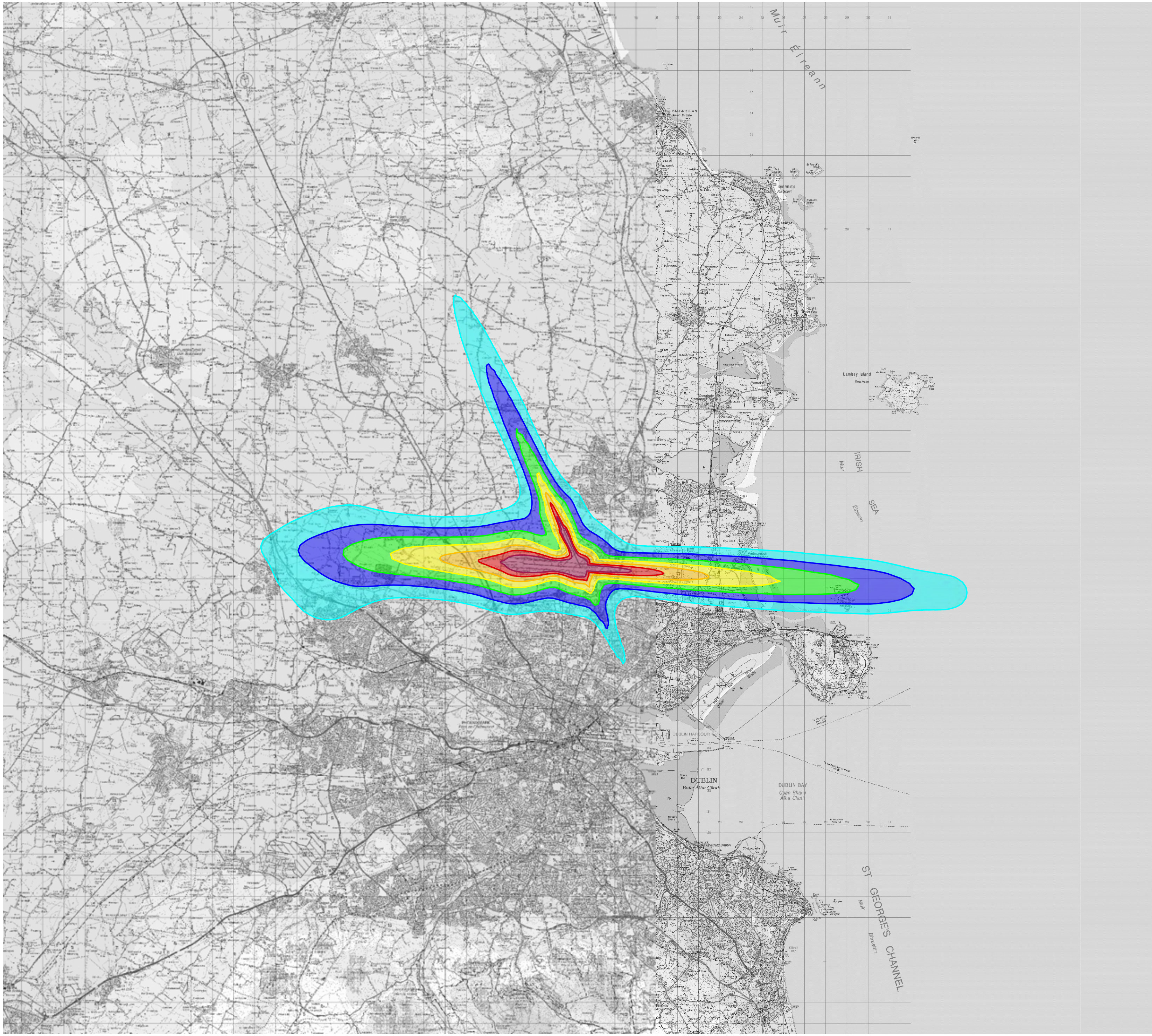
DATE: July 2021 SCALE: 1:250000@A4

Drawing No:

A11267_19_DR692_2.0



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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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Actual LAeq,8h Noise Contours
2018
Figure 13C-4

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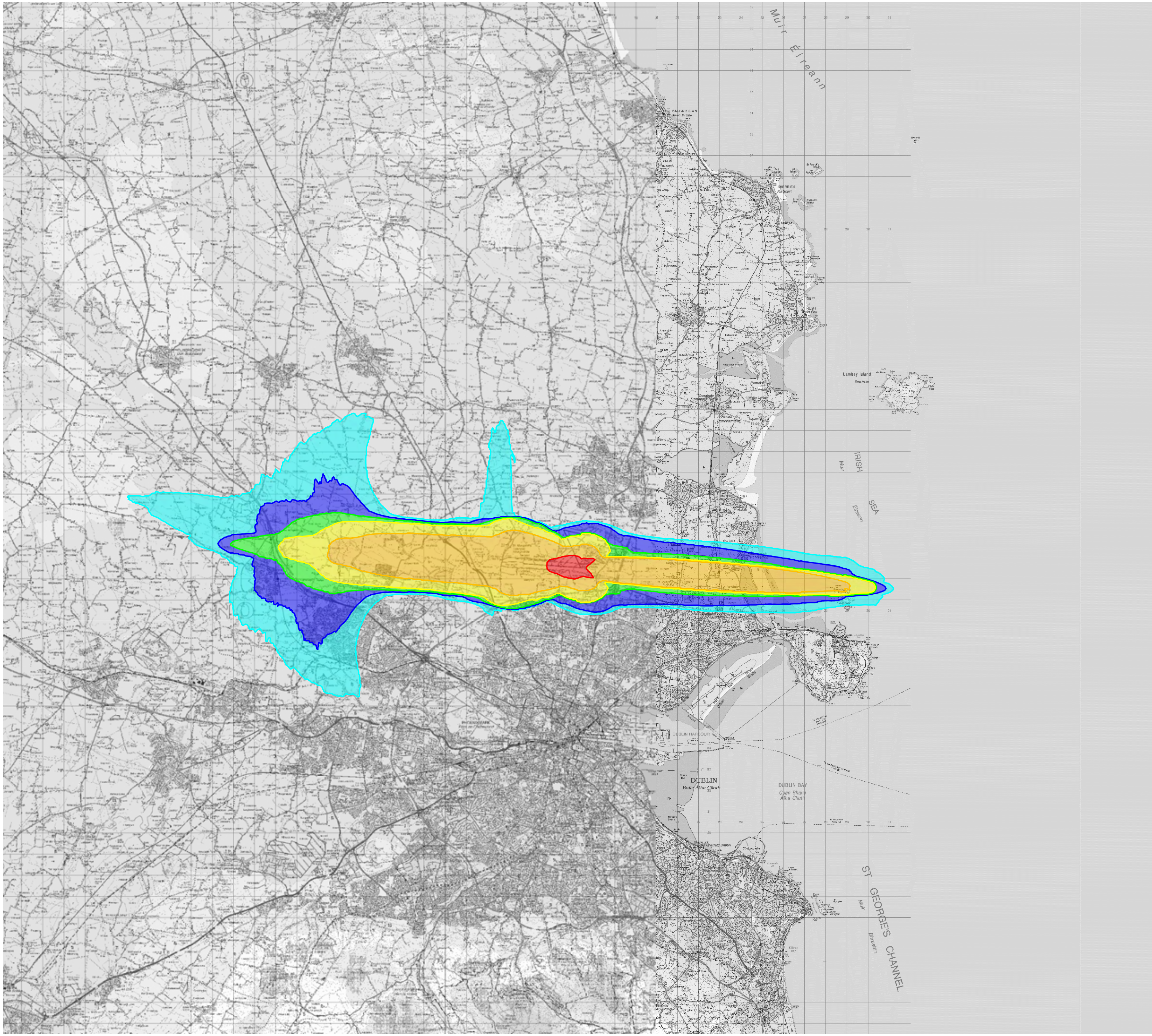
DATE: July 2021 | SCALE: 1:250000@A4

Drawing No:

A11267_19_DR693_2.0



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LEGEND:

- 10 - 24 N65
- 25 - 49 N65
- 50 - 99 N65
- 100 - 199 N65
- 200 - 499 N65
- 500+ N65

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Actual N65 Noise Contours
2018
Figure 13C-5

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Drawing No:

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LEGEND:

- 10 - 24 N60
- 25 - 49 N60
- 50+ N60

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Actual N60 Noise Contours
2018
Figure 13C-6

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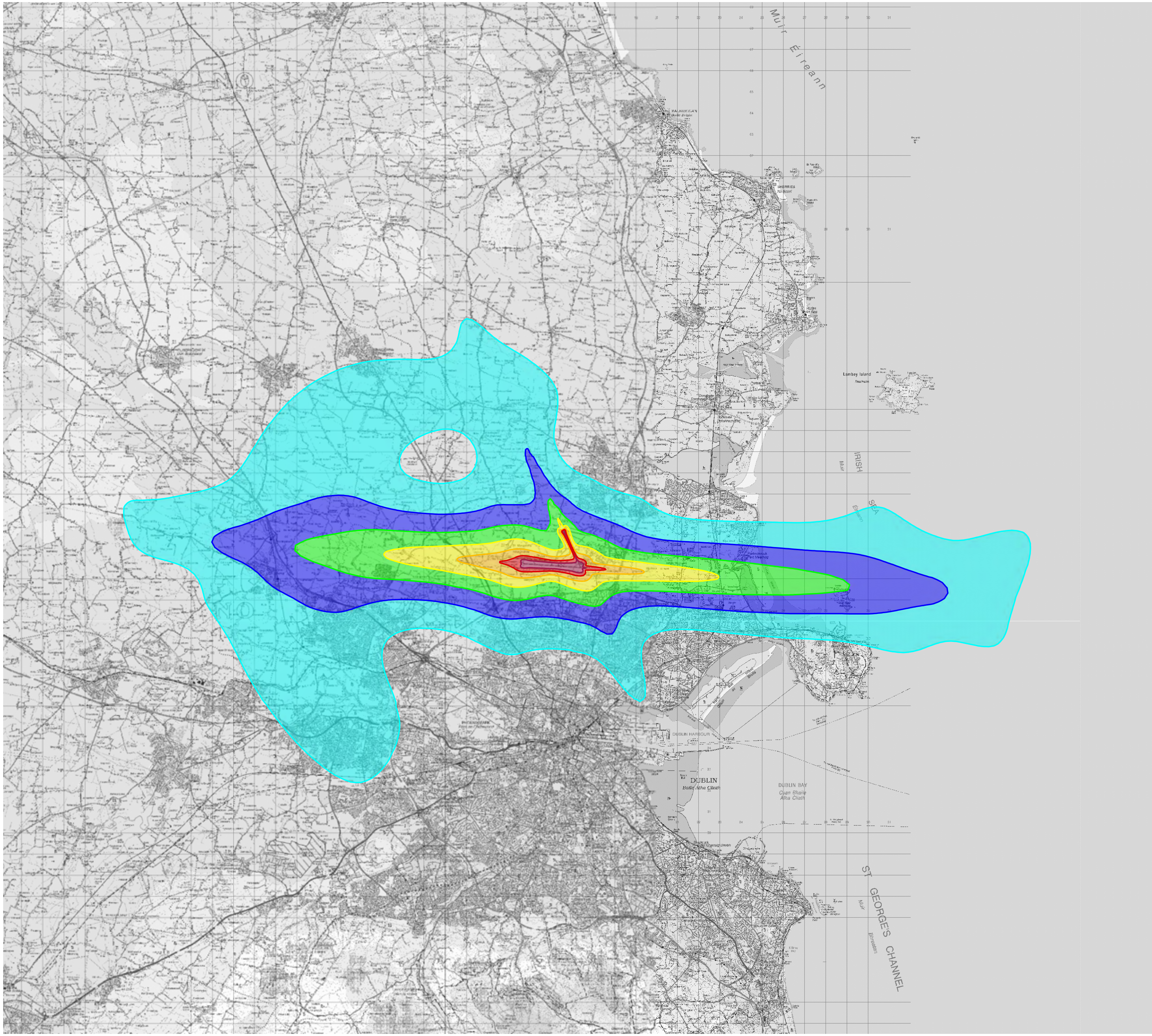

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LEGEND:

- 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}

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Actual Lday Noise Contours
2018
Figure 13C-7

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Drawing No:

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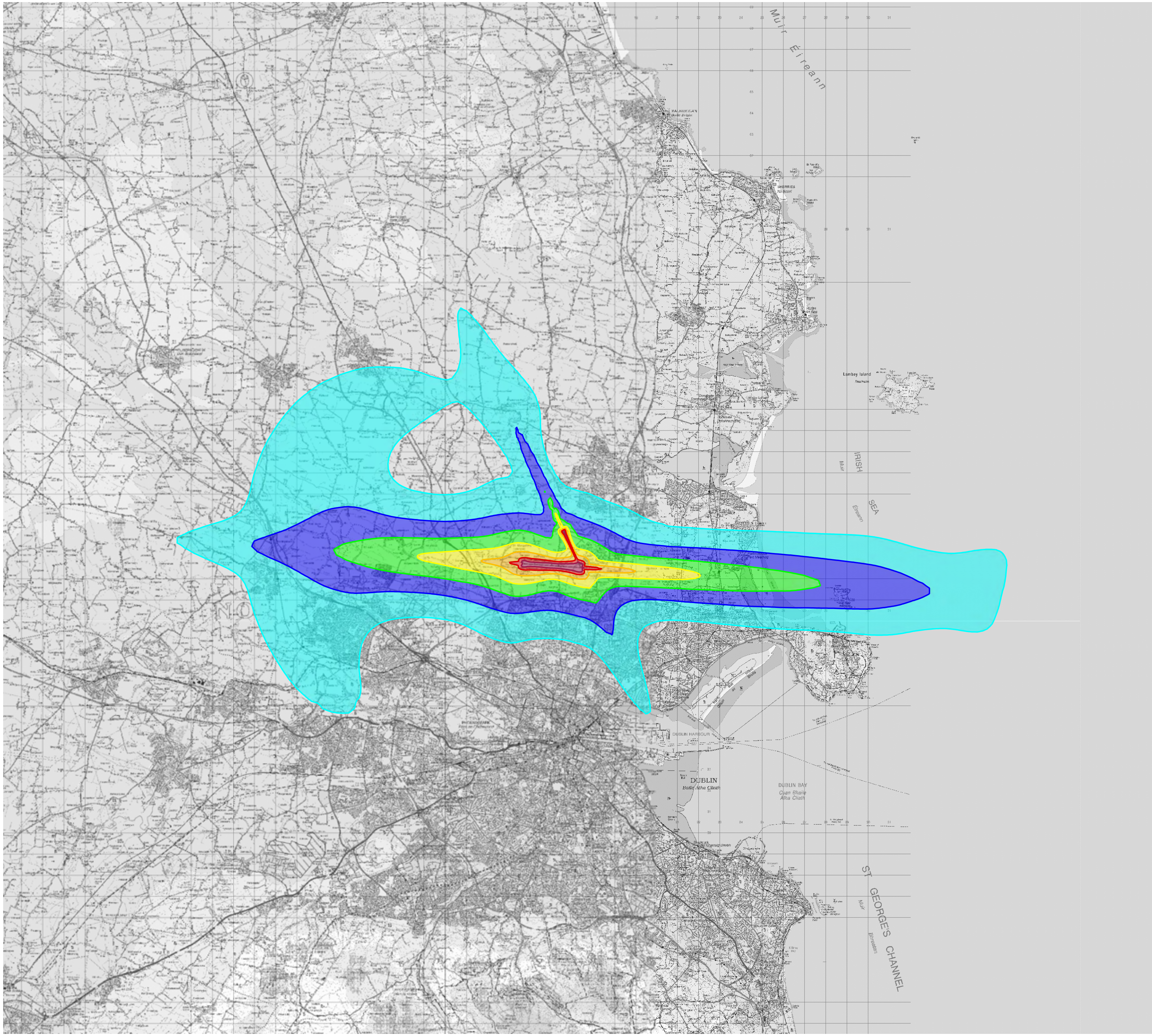

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LEGEND:

- 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) $L_{evening}$

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Actual Levening Noise Contours
2018
Figure 13C-8

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DATE: July 2021 SCALE: 1:250000@A4

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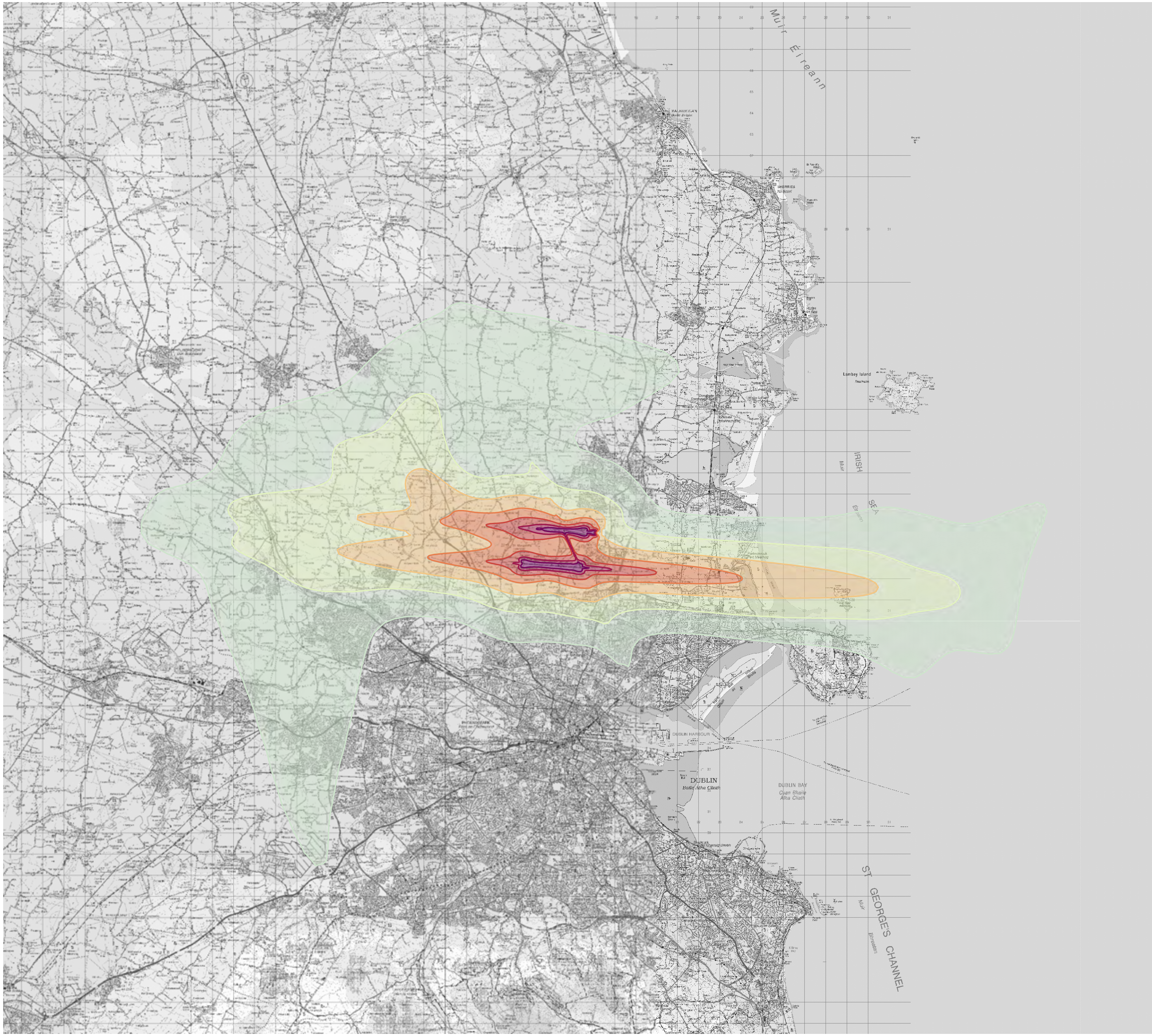

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LEGEND:

- 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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Forecast Lden Noise Contours
2022 Permitted Scenario
Figure 13C-9

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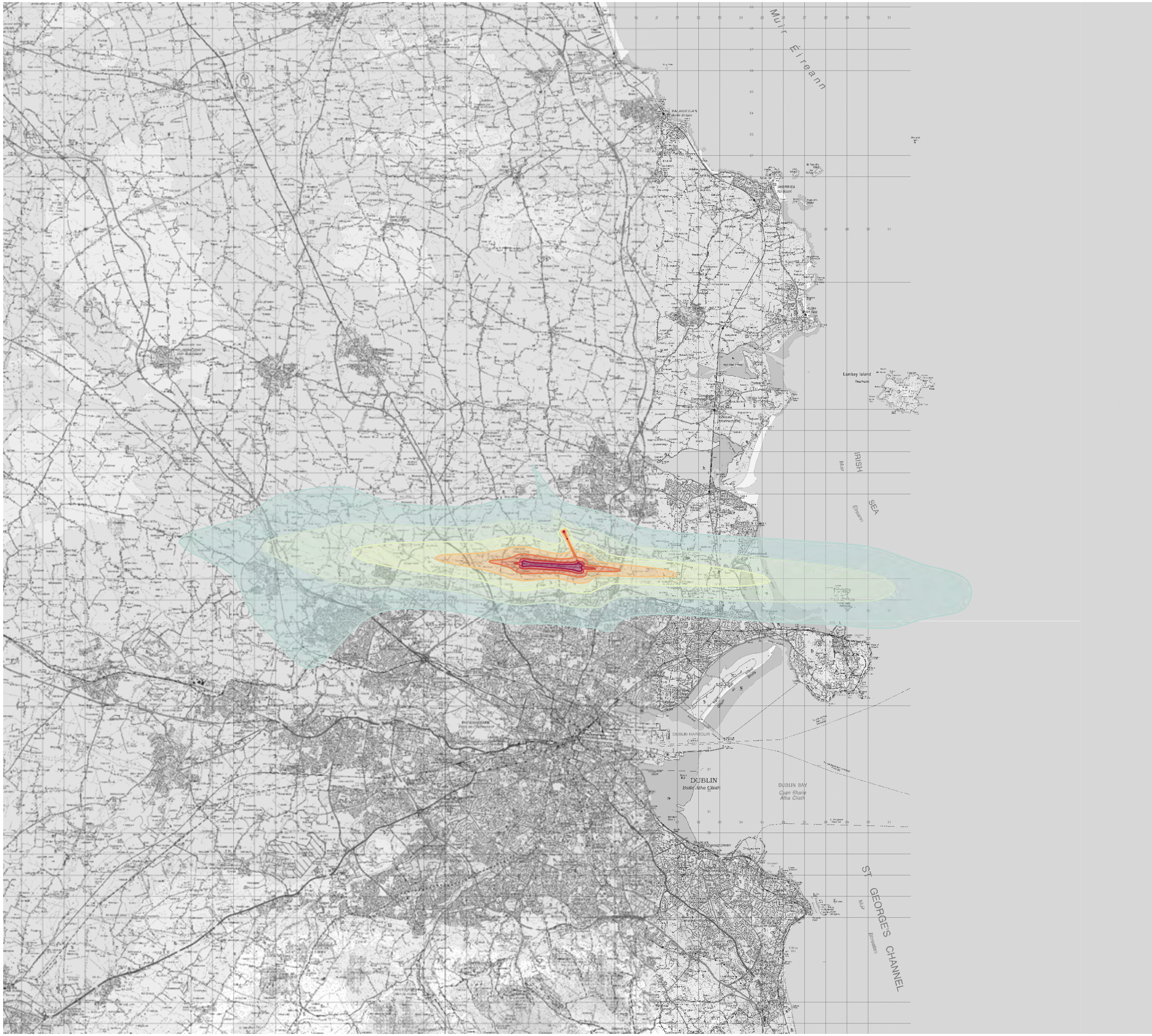

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LEGEND:

- 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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Forecast Lnight Noise Contours
2022 Permitted Scenario
Figure 13C-10

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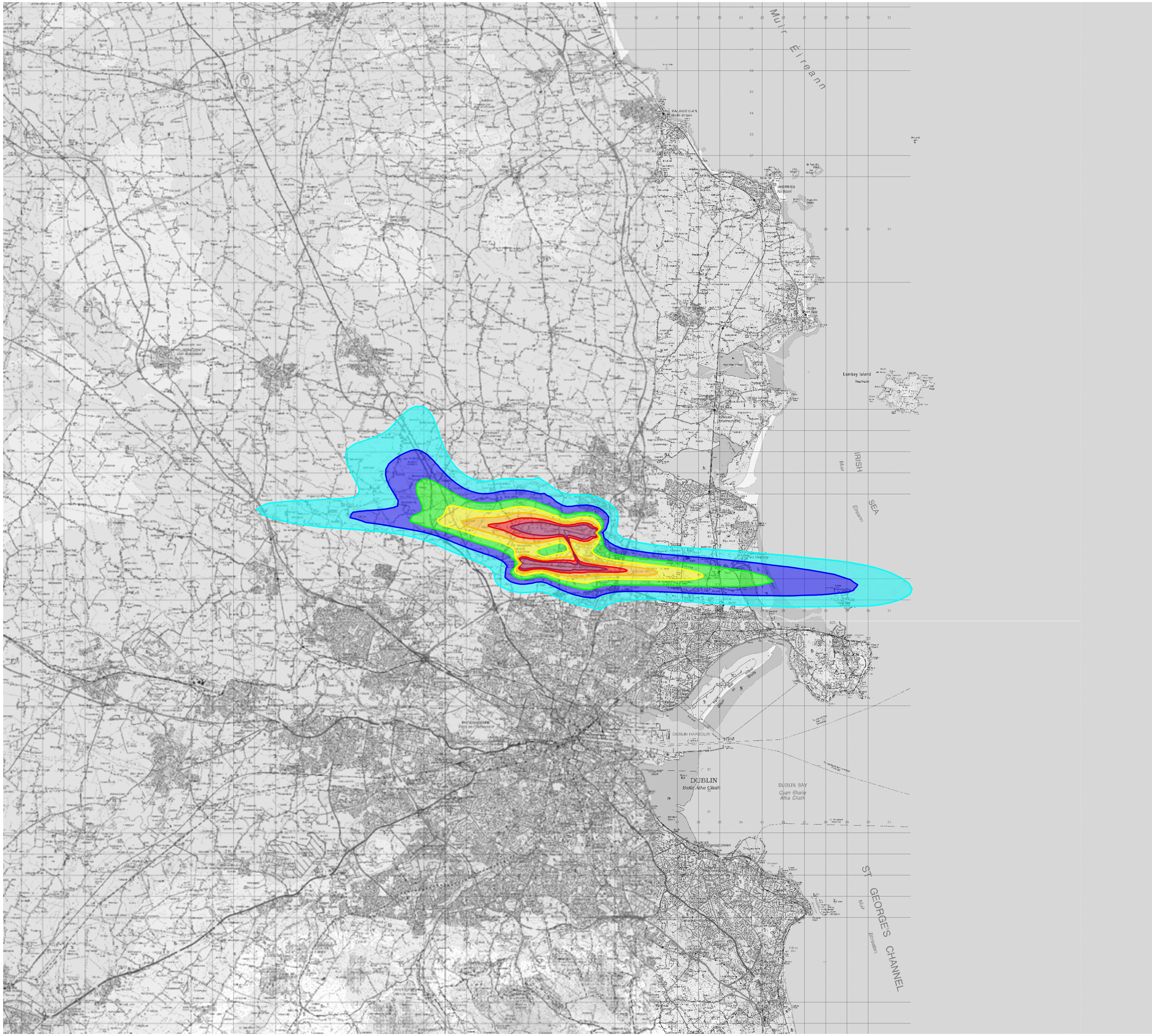

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LEGEND:

- 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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Forecast LAeq,16h Noise Contours
2022 Permitted Scenario
Figure 13C-11

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Drawing No:

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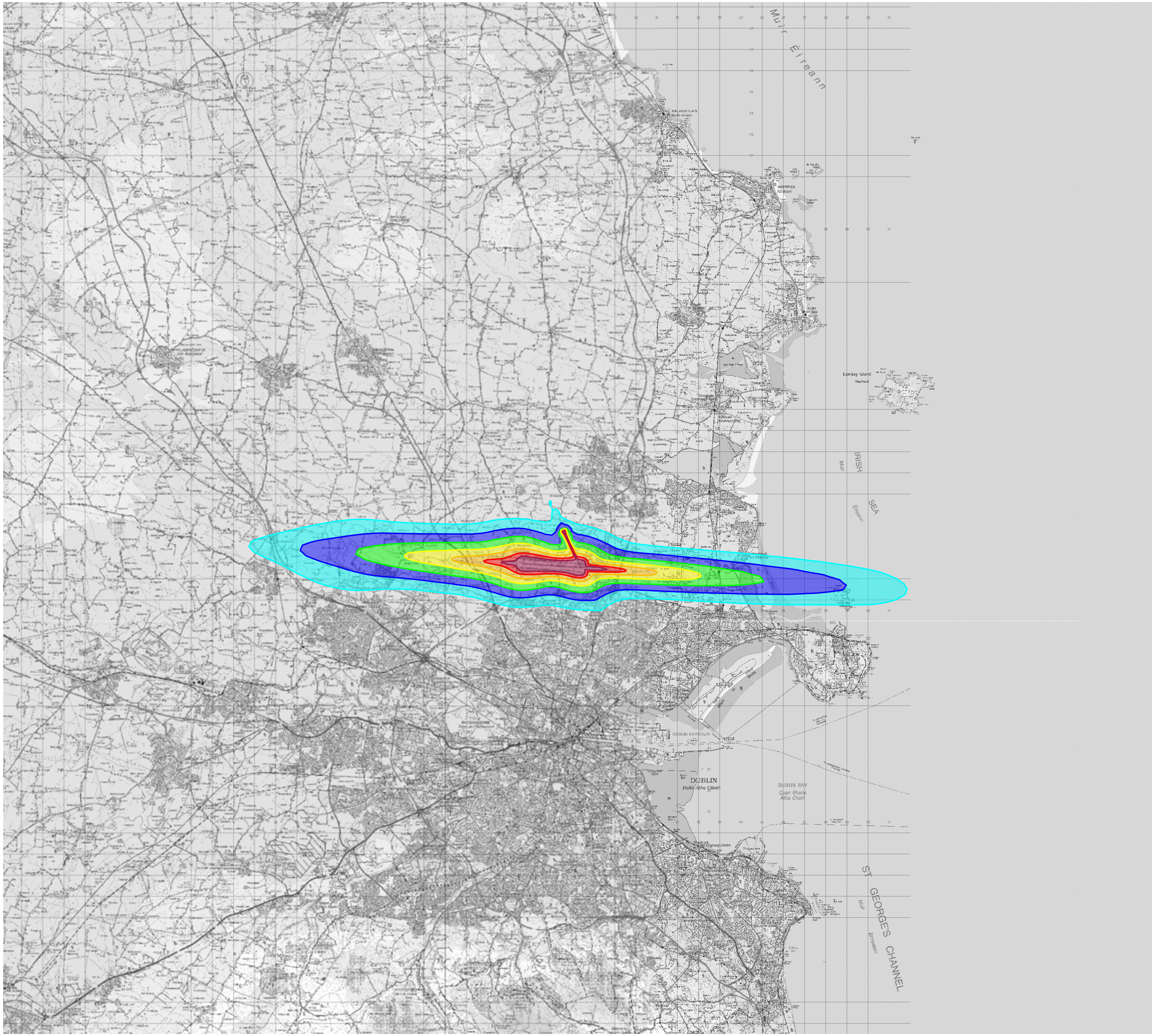

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LEGEND:

- 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 13C-12

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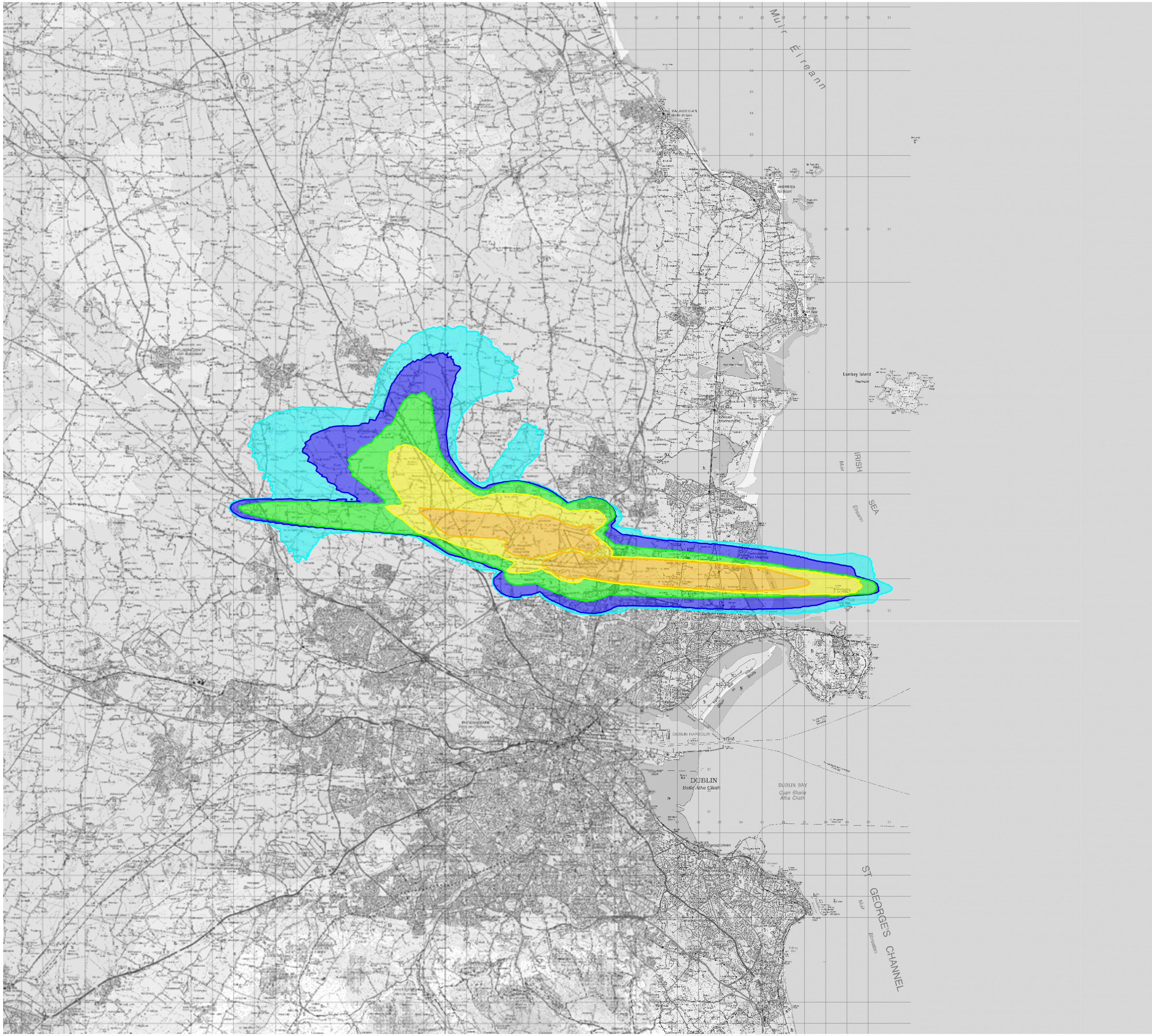

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LEGEND:

- 10 - 24 N65
- 25 - 49 N65
- 50 - 99 N65
- 100 - 199 N65
- 200 - 499 N65
- 500+ N65

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Forecast N65 Noise Contours
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Figure 13C-13

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A11267_19_DR702_2.0

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LEGEND:

- 10 - 24 N60
- 25 - 49 N60
- 50+ N60

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Forecast N60 Noise Contours
2022 Permitted Scenario
Figure 13C-14

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SCALE: 1:250000@A4

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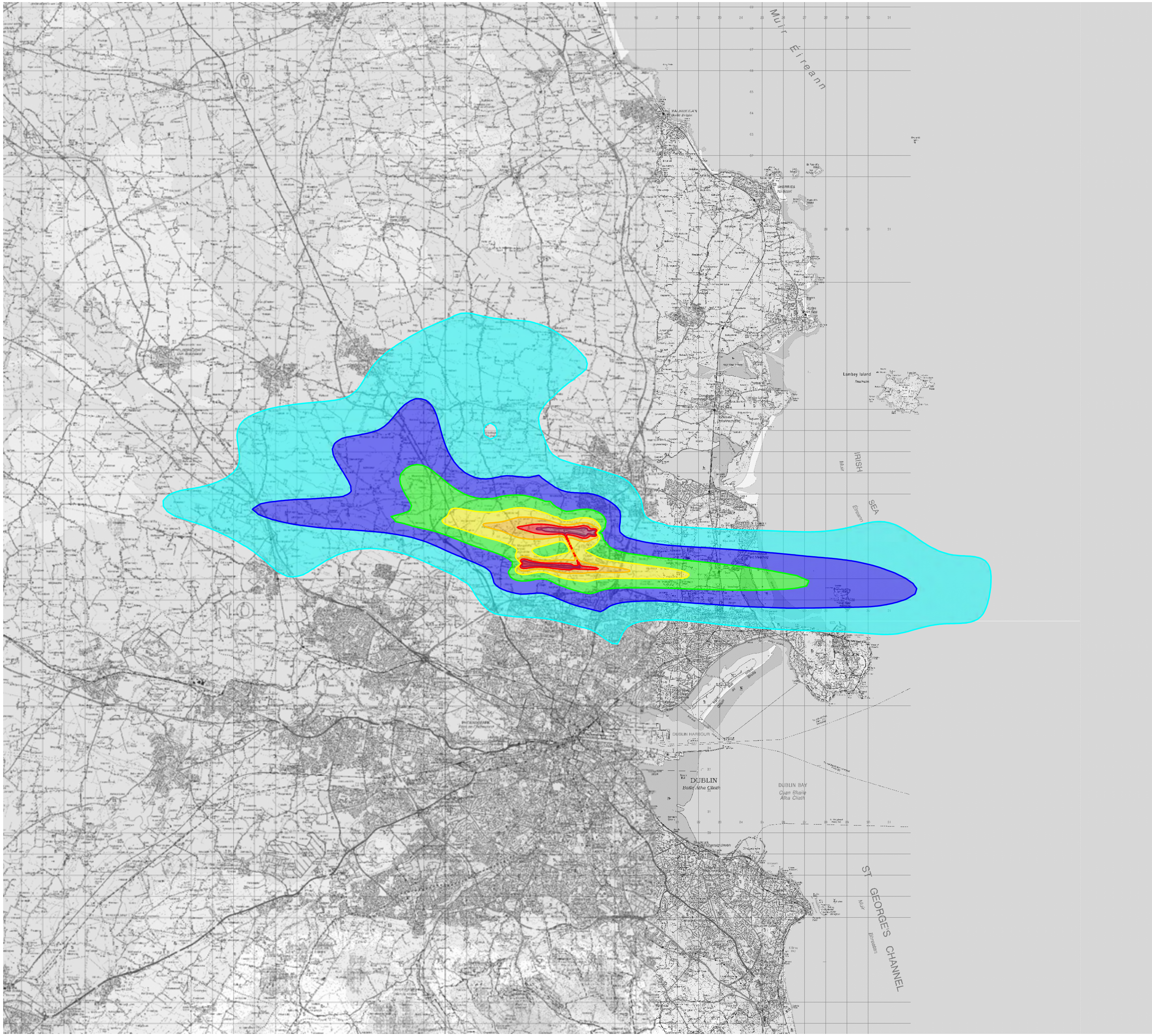

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LEGEND:

- 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}

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Forecast Lday Noise Contours
2022 Permitted Scenario
Figure 13C-15

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DATE: July 2021 SCALE: 1:250000@A4

Drawing No:

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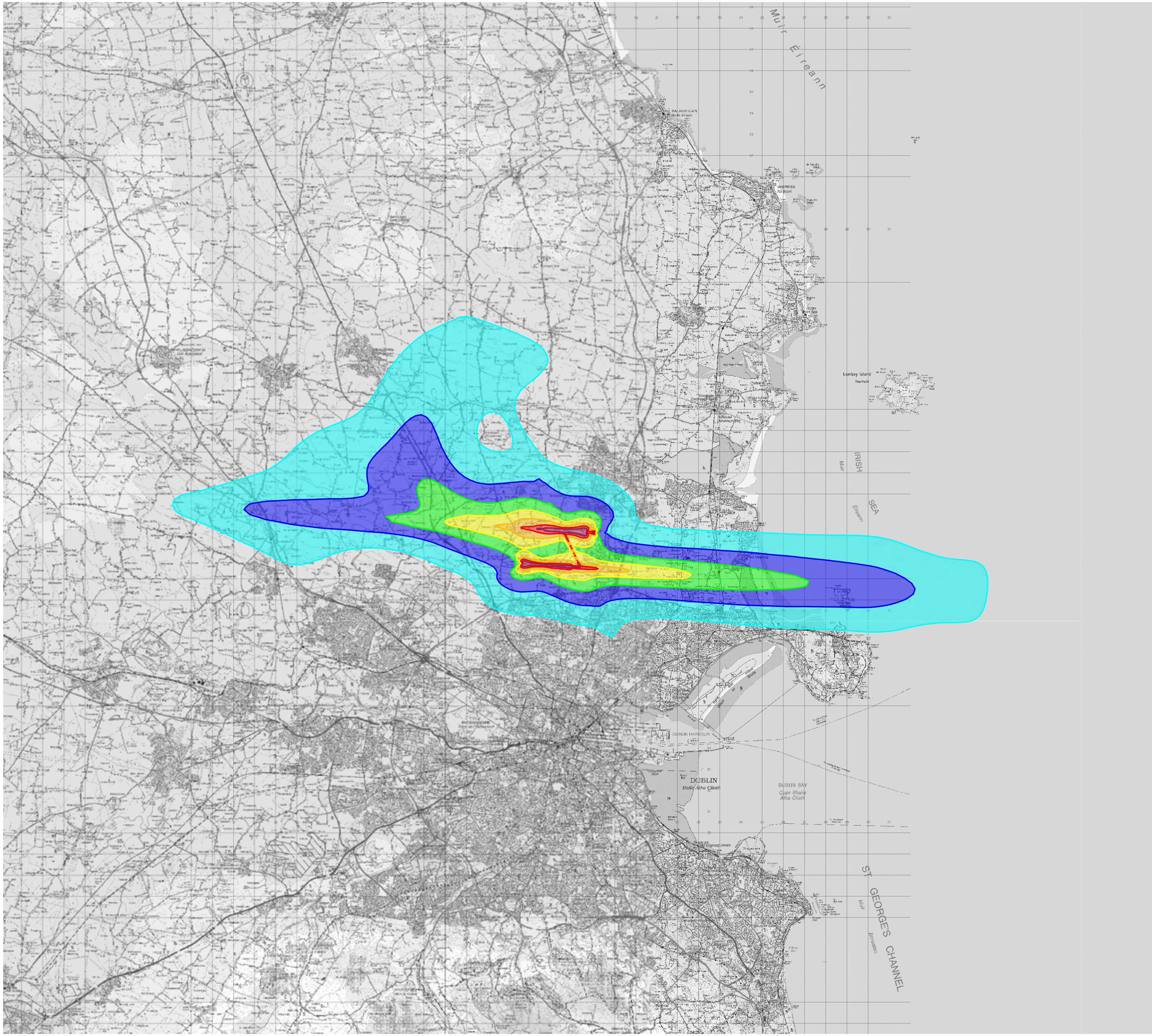

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LEGEND:

- 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) $L_{evening}$

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Forecast Levening Noise Contours
2022 Permitted Scenario
Figure 13C-16

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DATE: July 2021 SCALE: 1:250000@A4

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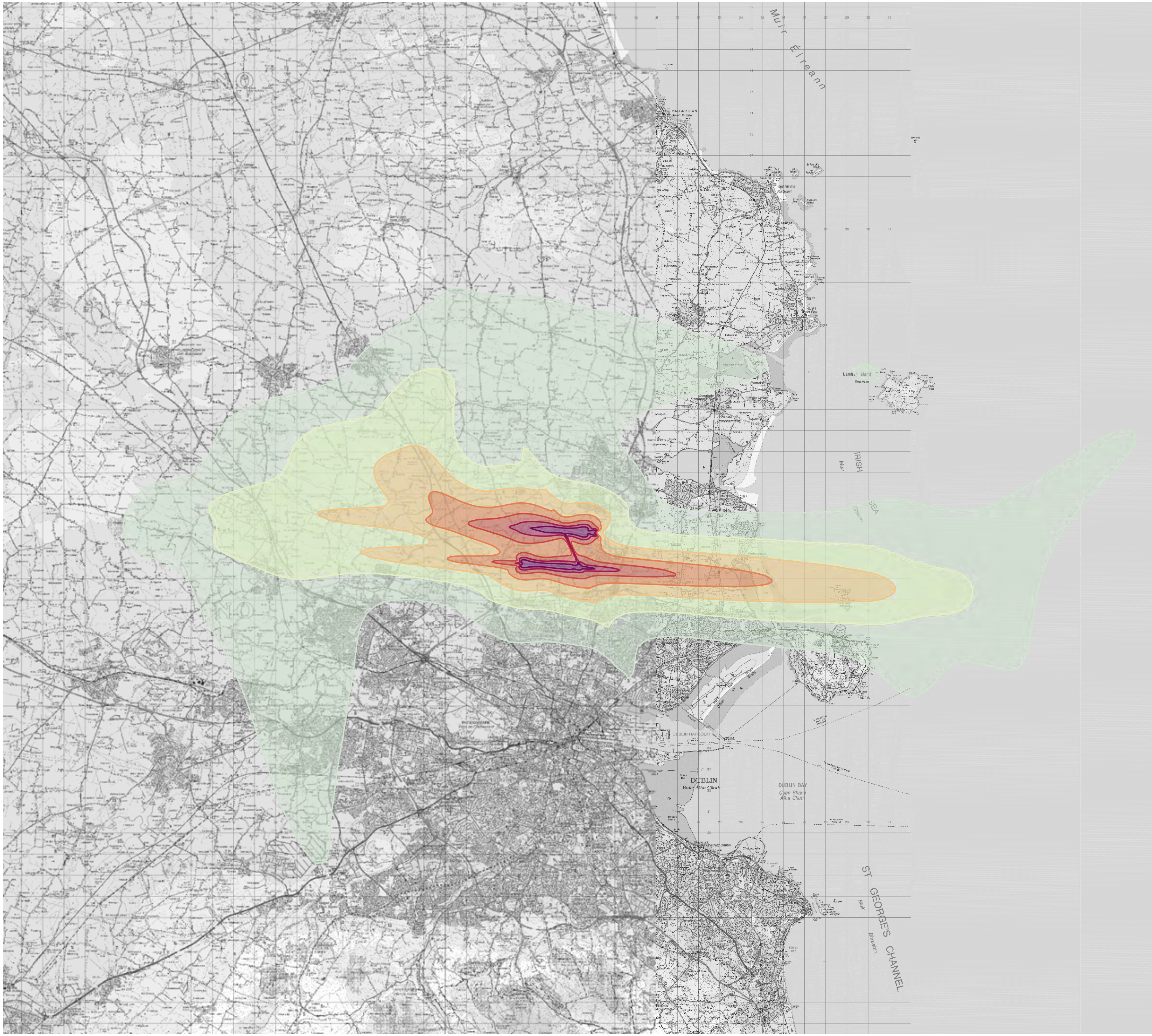

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LEGEND:

- 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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Forecast Lden Noise Contours
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Figure 13C-17

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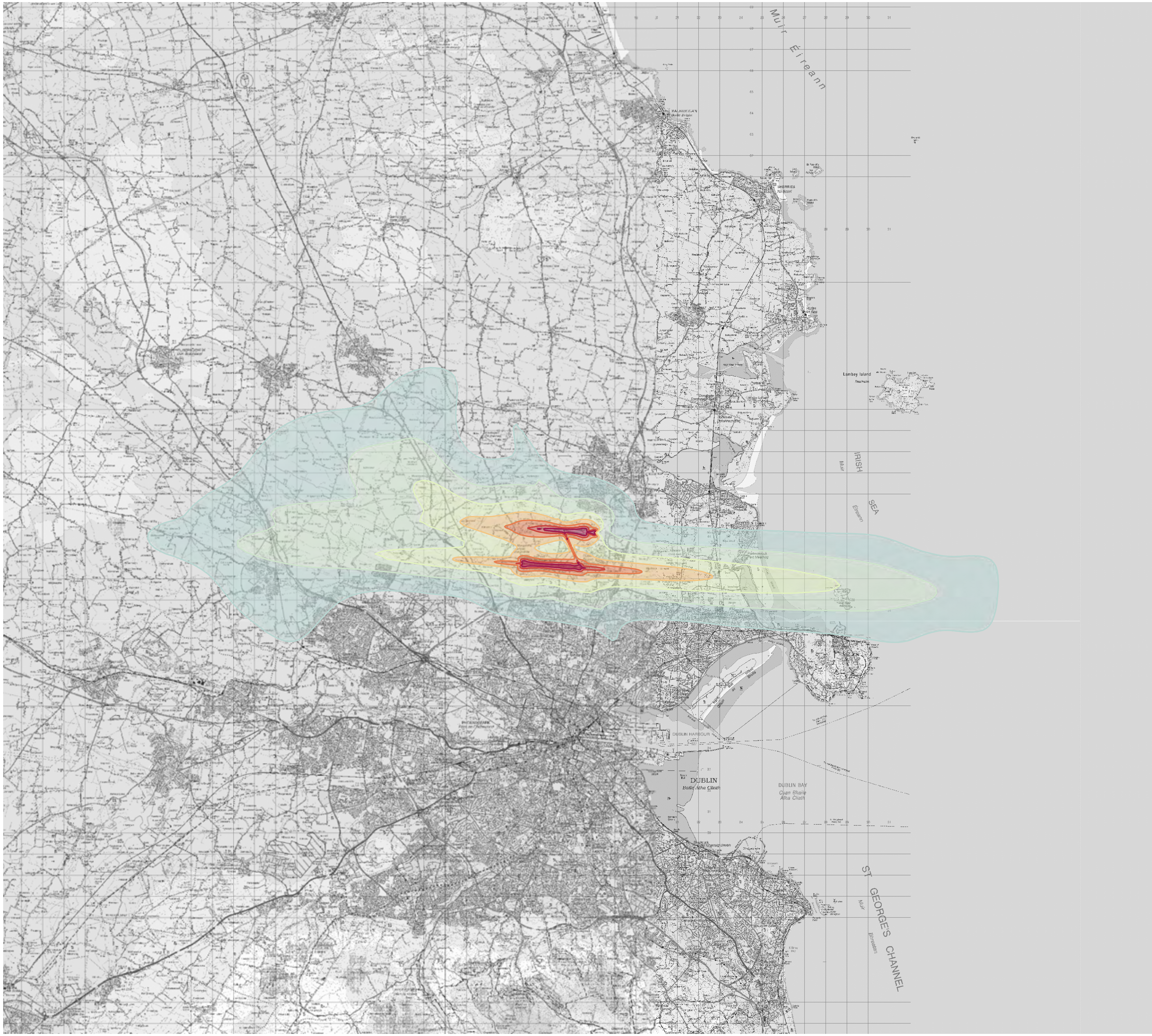

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LEGEND:

- 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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Forecast Lnight Noise Contours
2022 Proposed Scenario
Figure 13C-18

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DATE: July 2021 SCALE: 1:250000@A4

Drawing No:

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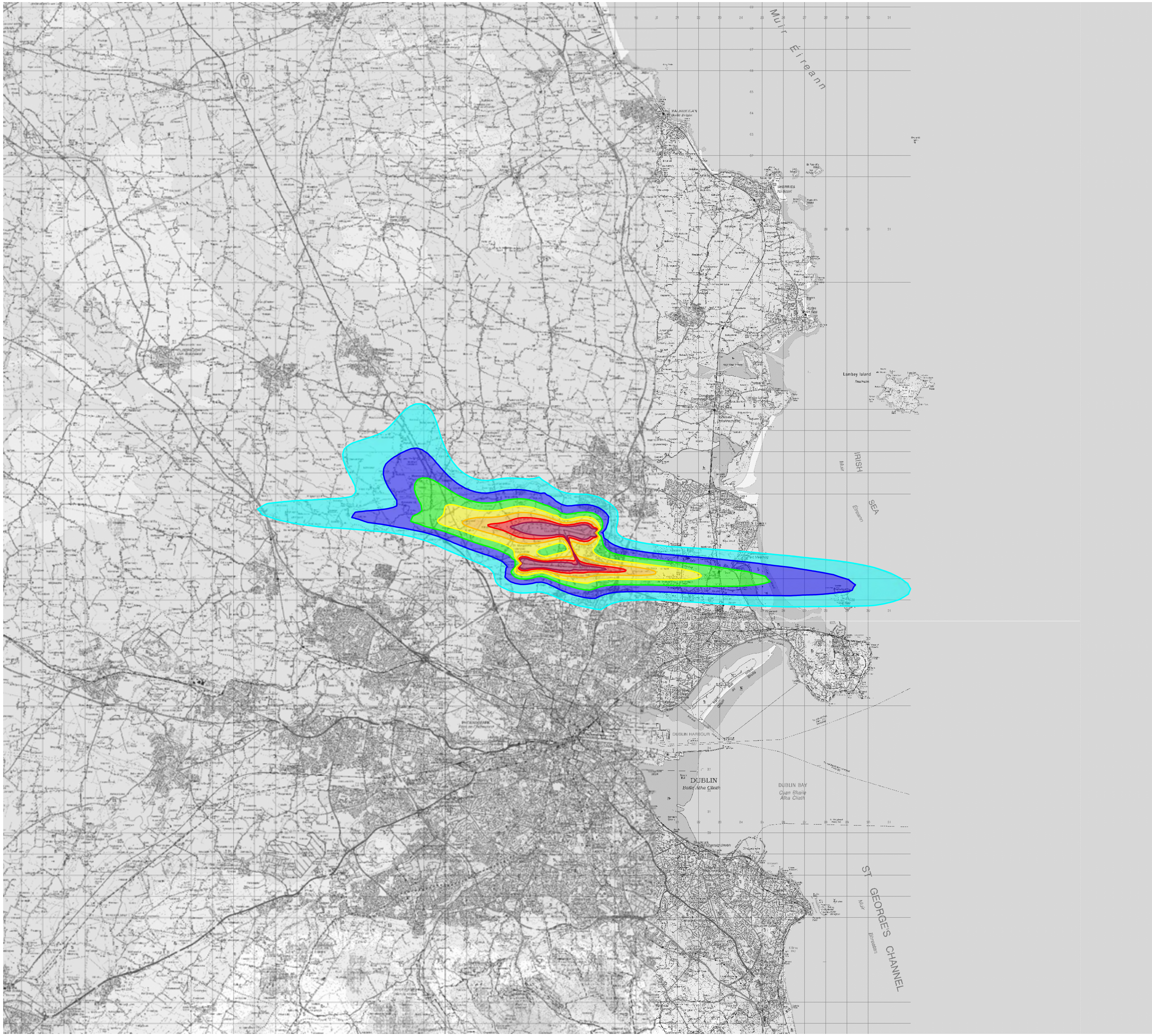

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LEGEND:

- 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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Forecast LAeq,16h Noise Contours
2022 Proposed Scenario
Figure 13C-19

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DATE: July 2021
SCALE: 1:250000@A4

Drawing No:

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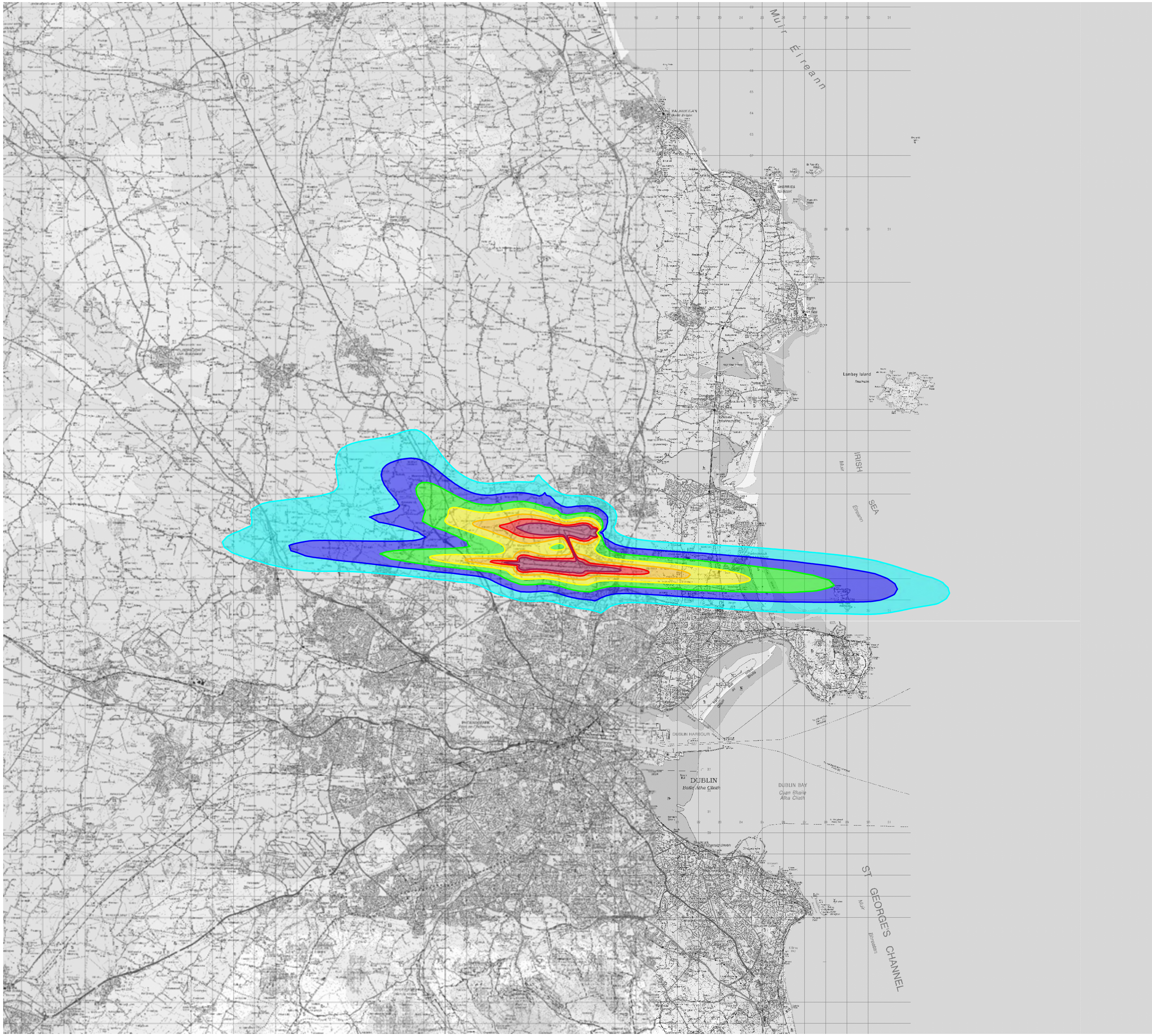

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LEGEND:

- 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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Forecast LAeq,8h Noise Contours
2022 Proposed Scenario
Figure 13C-20

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DATE: July 2021 SCALE: 1:250000@A4

Drawing No:

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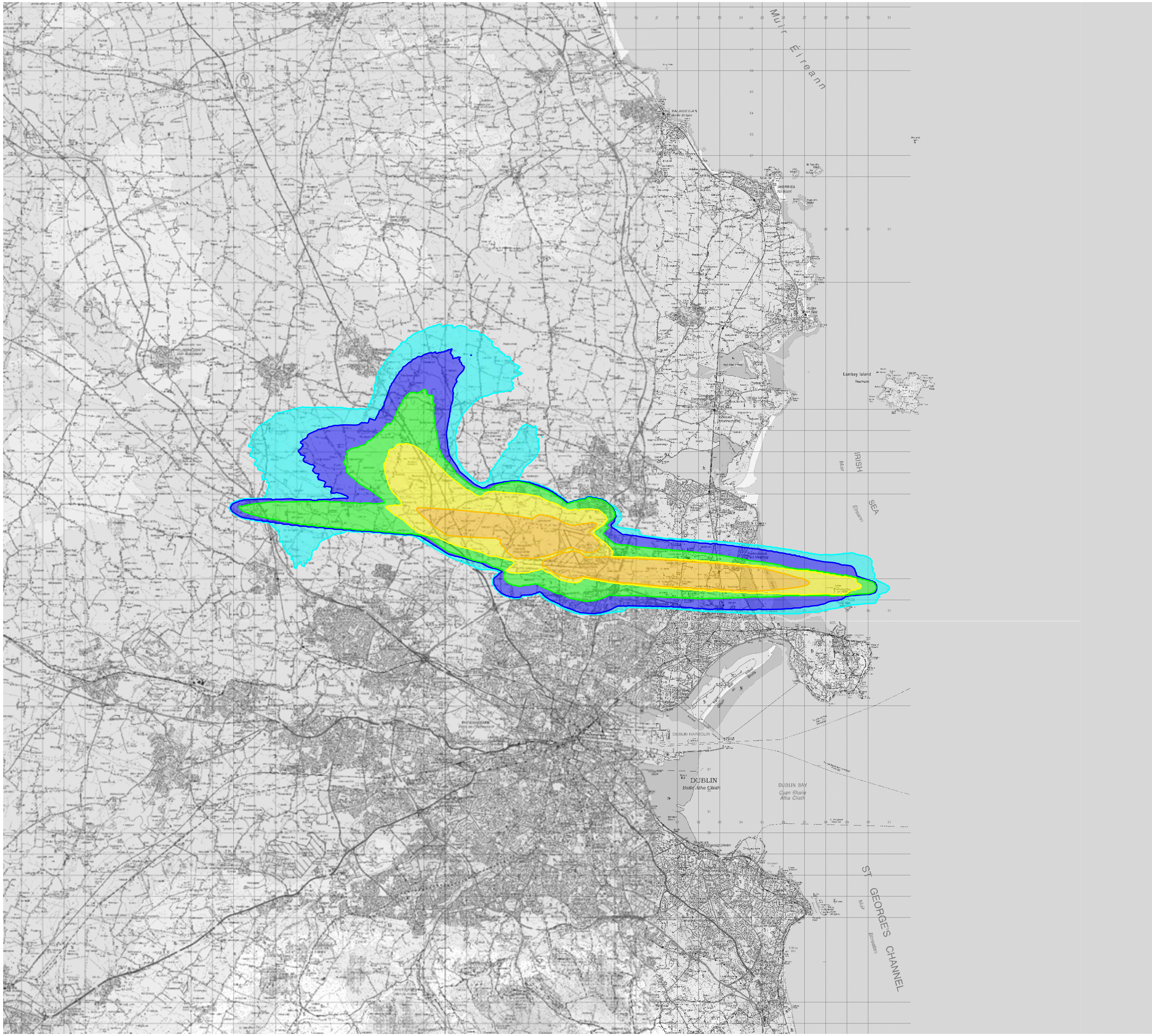

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LEGEND:

- 10 - 24 N65
- 25 - 49 N65
- 50 - 99 N65
- 100 - 199 N65
- 200 - 499 N65
- 500+ N65

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Forecast N65 Noise Contours
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Figure 13C-21

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Drawing No:

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LEGEND:

- 10 - 24 N60
- 25 - 49 N60
- 50+ N60

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Forecast N60 Noise Contours
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Figure 13C-22

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Drawing No:

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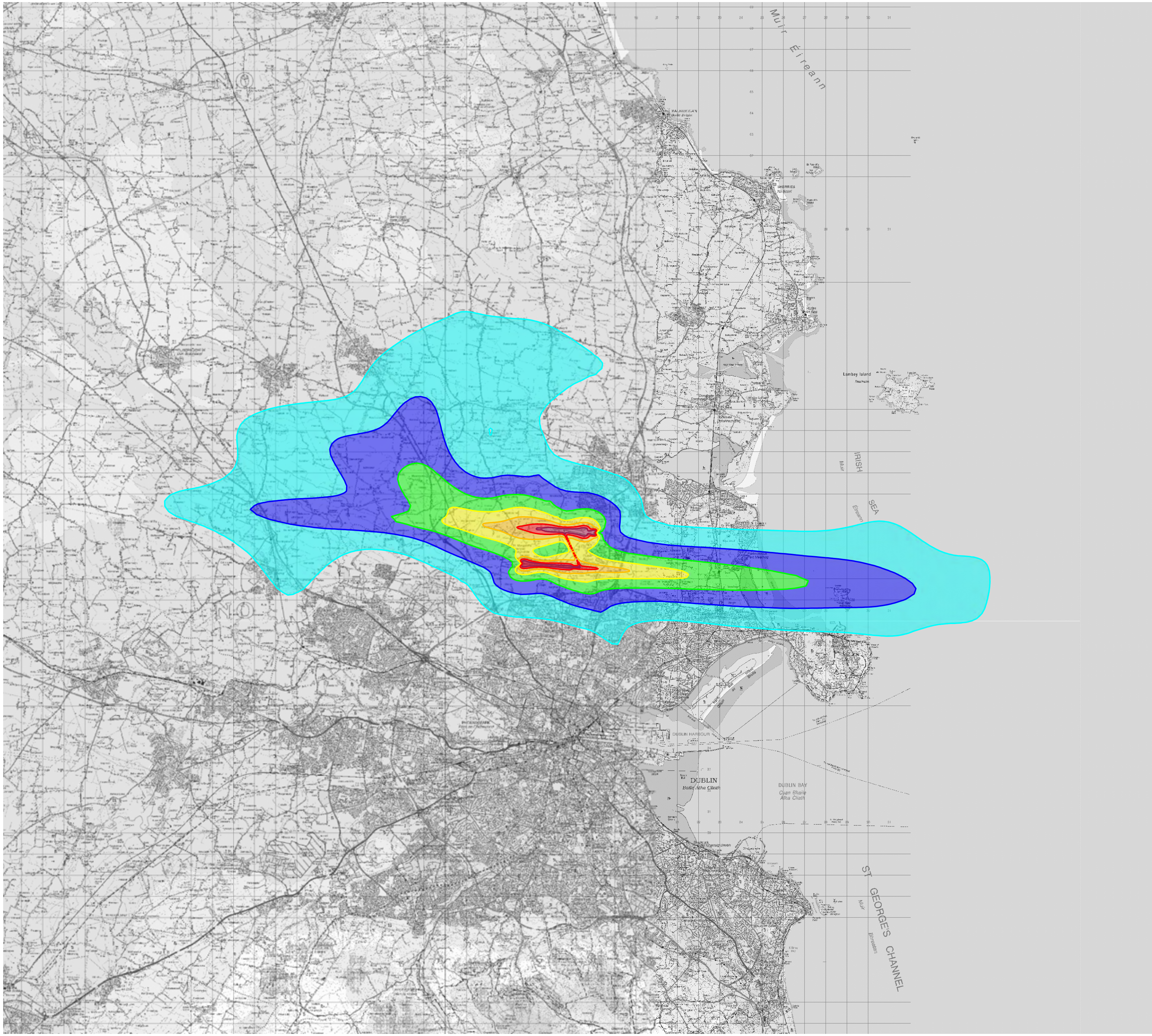

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LEGEND:

- 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}

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Forecast Lday Noise Contours
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Figure 13C-23

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Drawing No:

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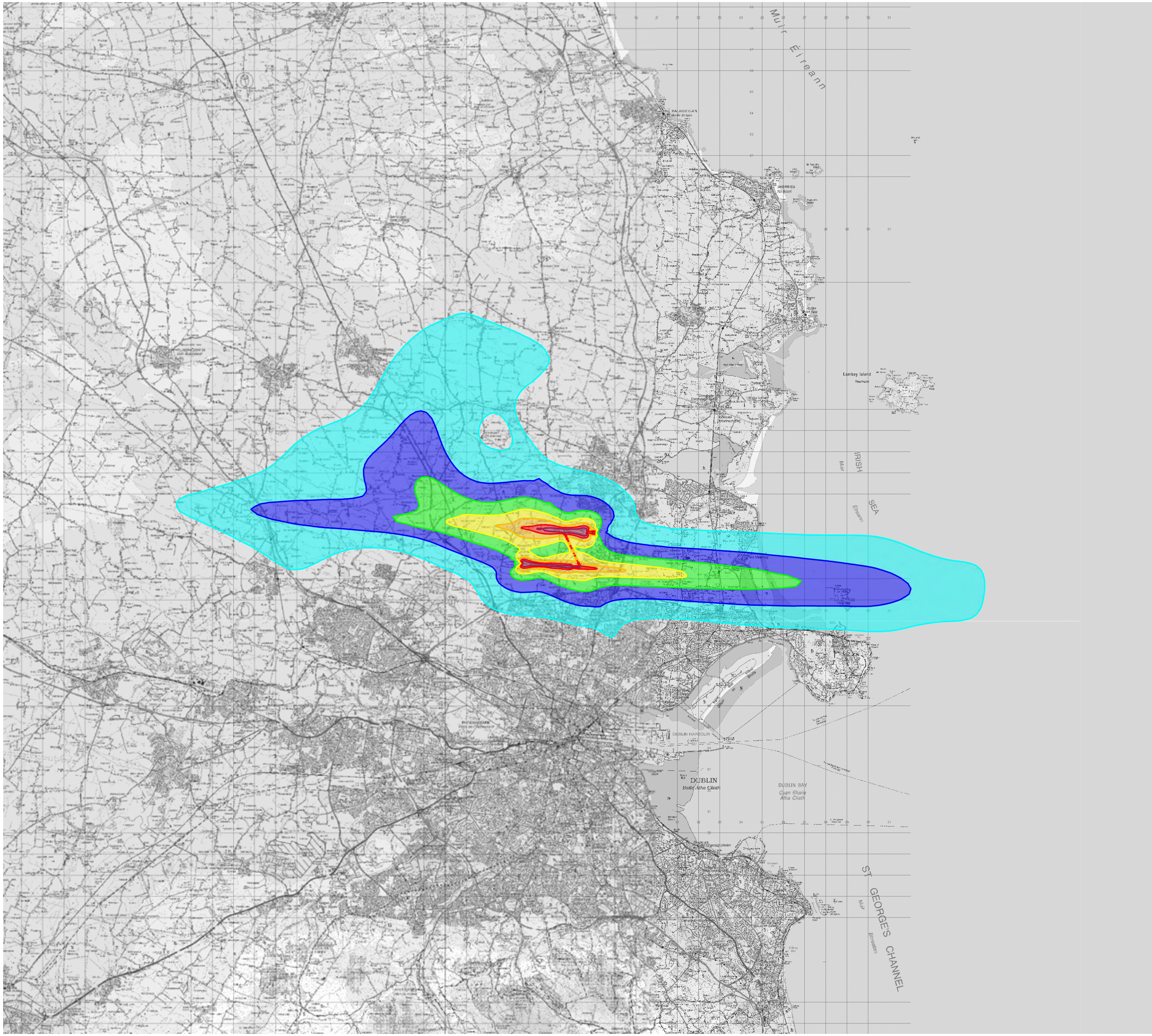

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LEGEND:

- 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) $L_{evening}$

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Figure 13C-24

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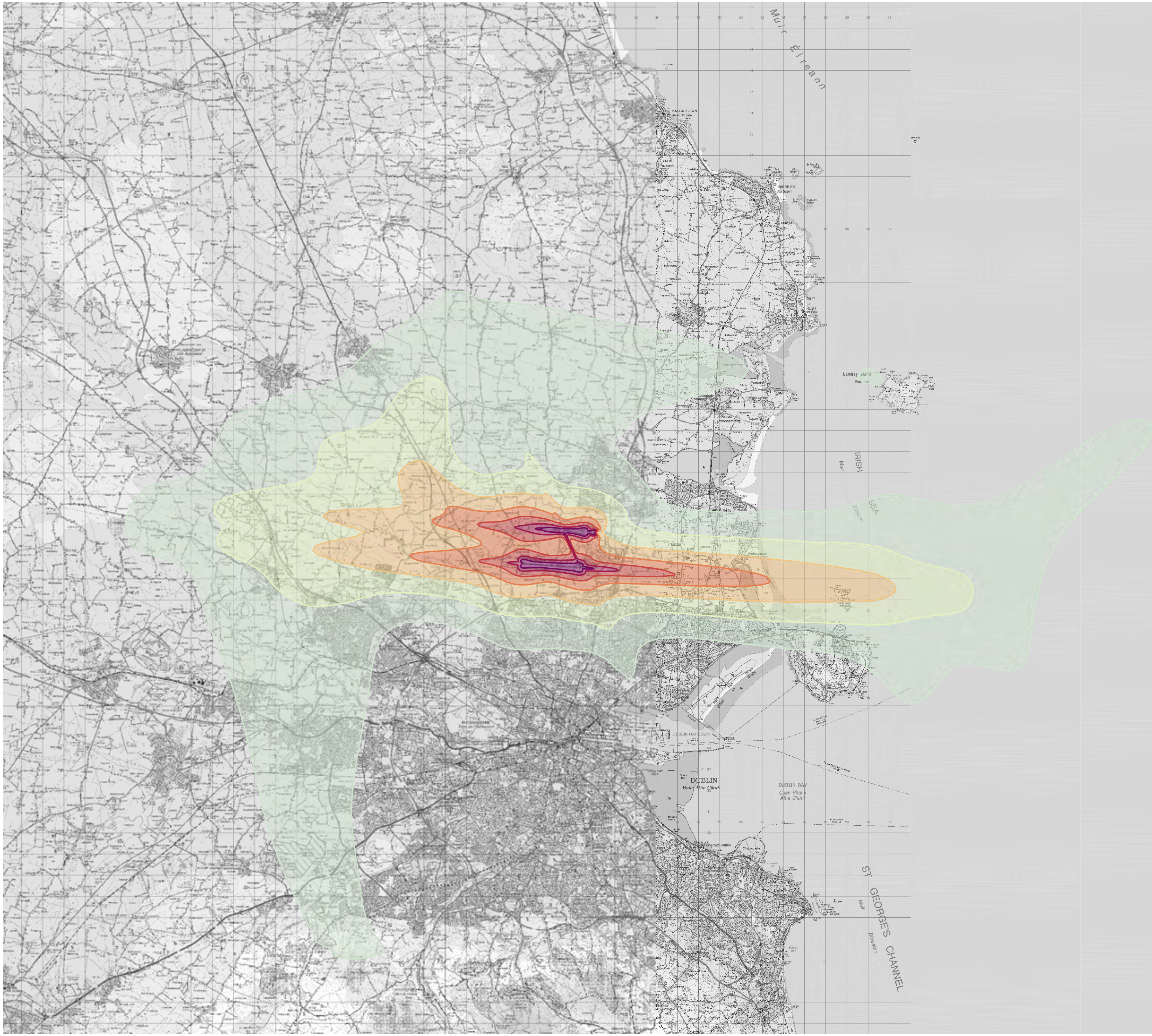

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LEGEND:

- 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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Forecast Lden Noise Contours
2025 Permitted Scenario
Figure 13C-25

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DATE: July 2021 | SCALE: 1:250000@A4

Drawing No:

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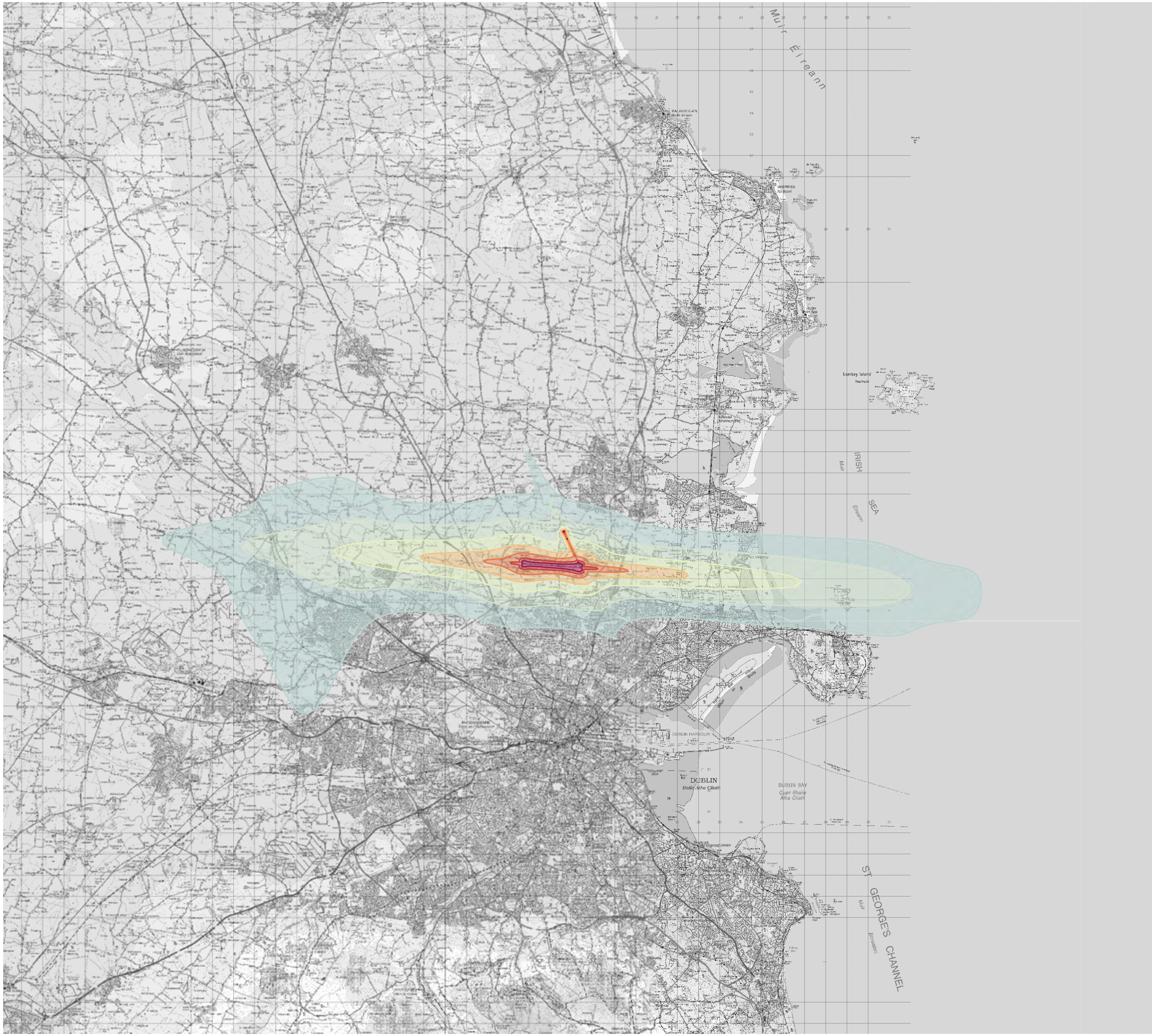

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LEGEND:

- 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 13C-26

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DATE: July 2021 SCALE: 1:250000@A4

Drawing No:

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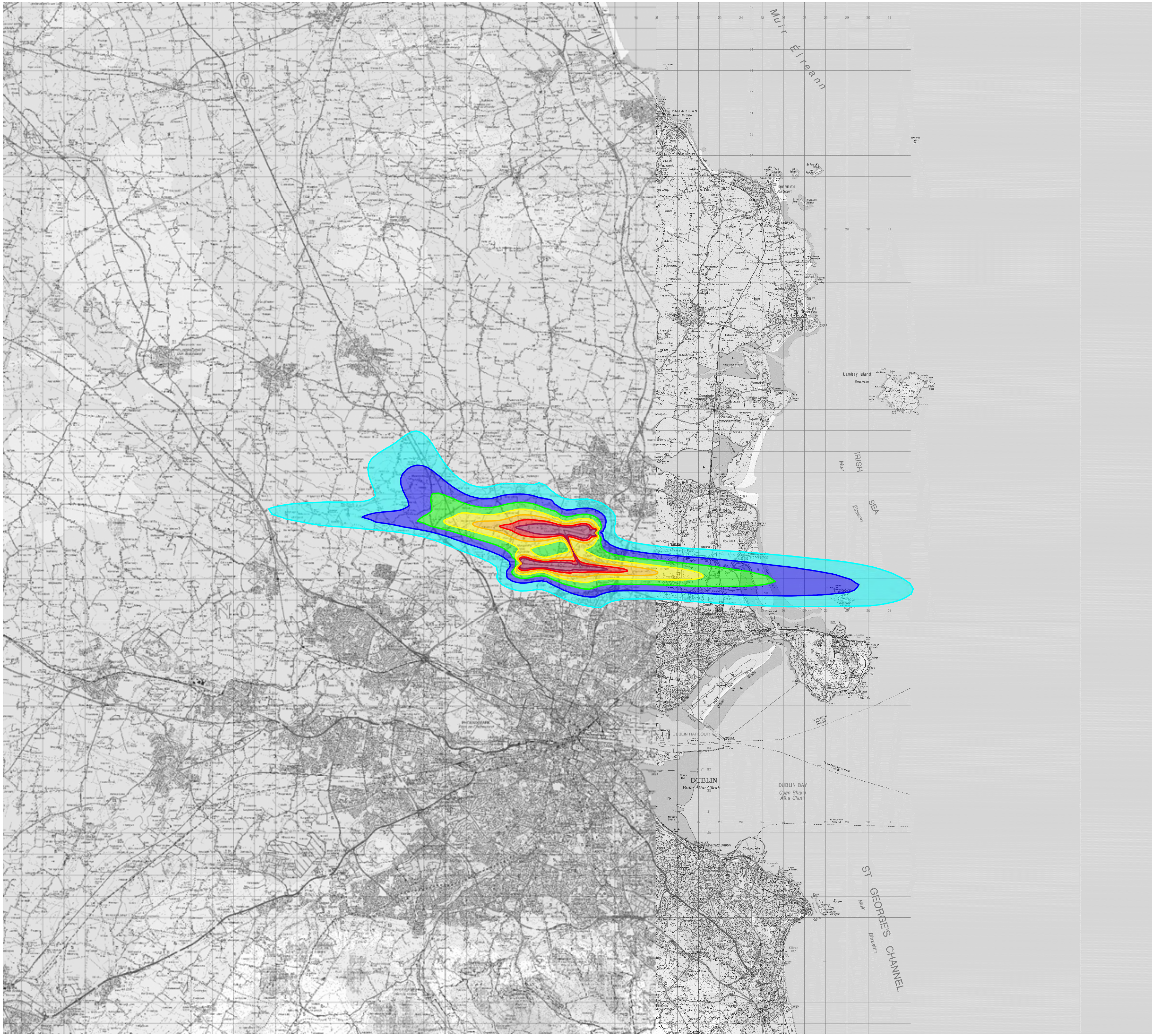

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LEGEND:

- 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 13C-27

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Drawing No:

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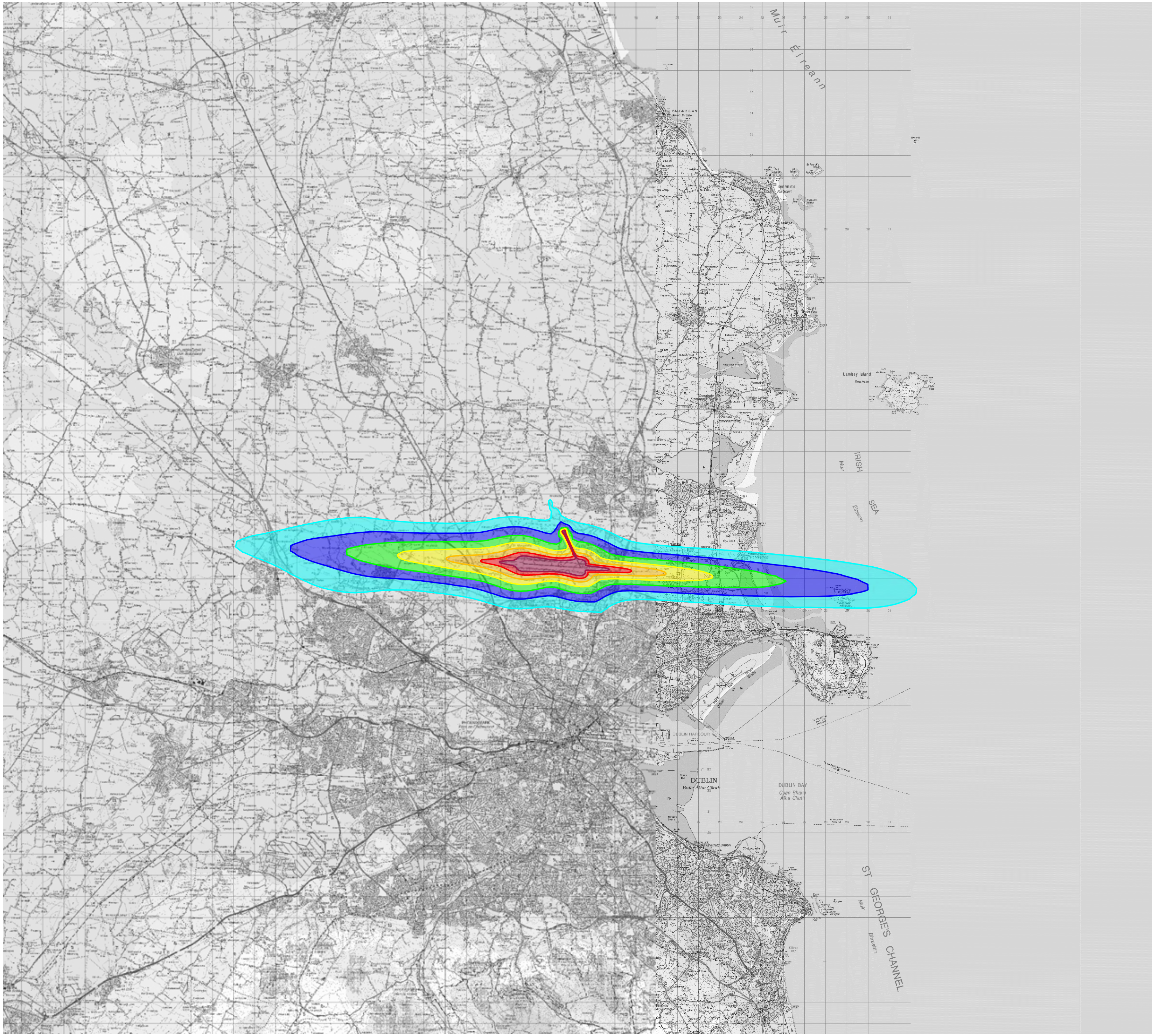

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LEGEND:

- 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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Forecast LAeq,8h Noise Contours
2025 Permitted Scenario
Figure 13C-28

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Drawing No:

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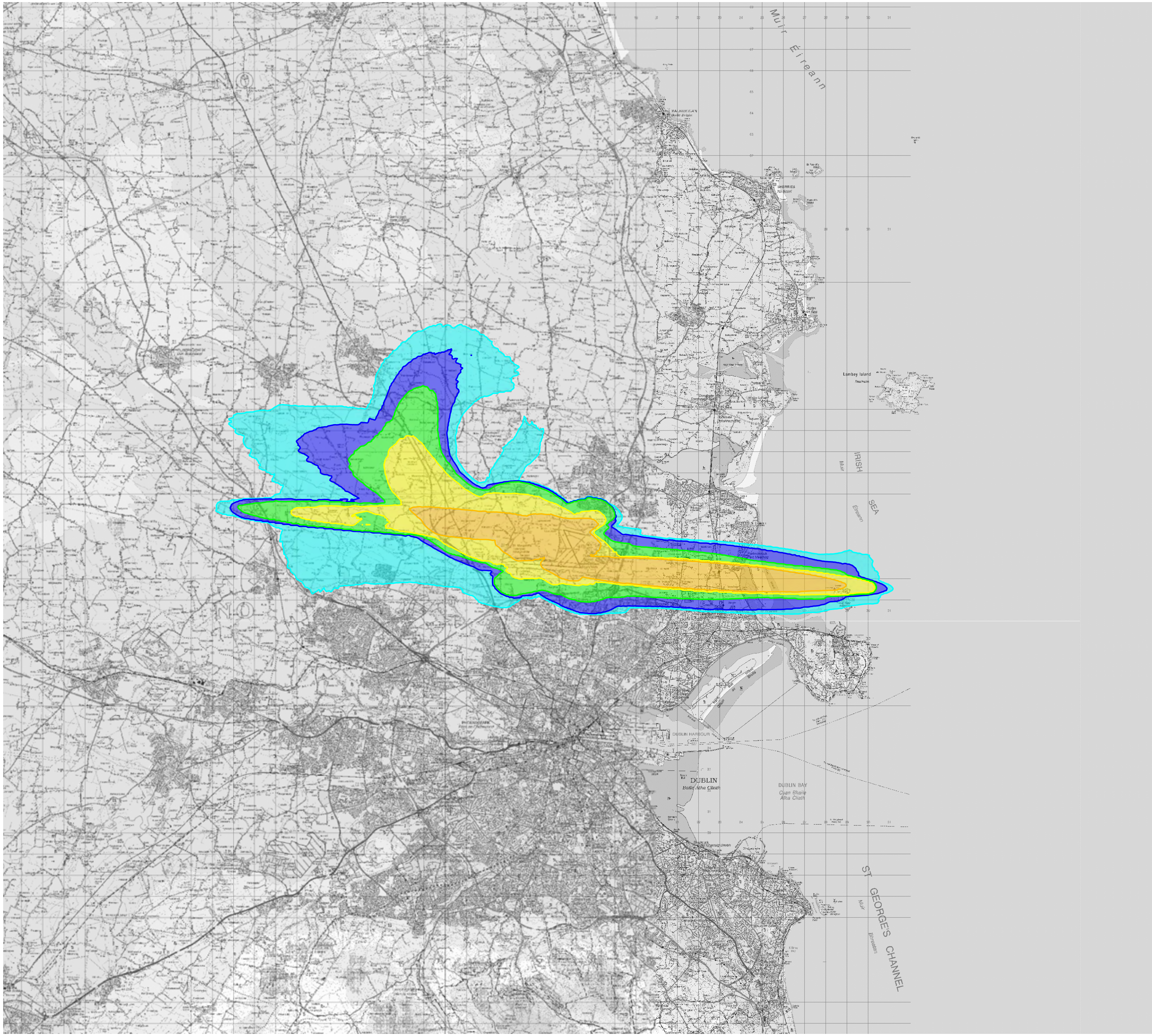

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LEGEND:

- 10 - 24 N65
- 25 - 49 N65
- 50 - 99 N65
- 100 - 199 N65
- 200 - 499 N65
- 500+ N65

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Figure 13C-29

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Drawing No:

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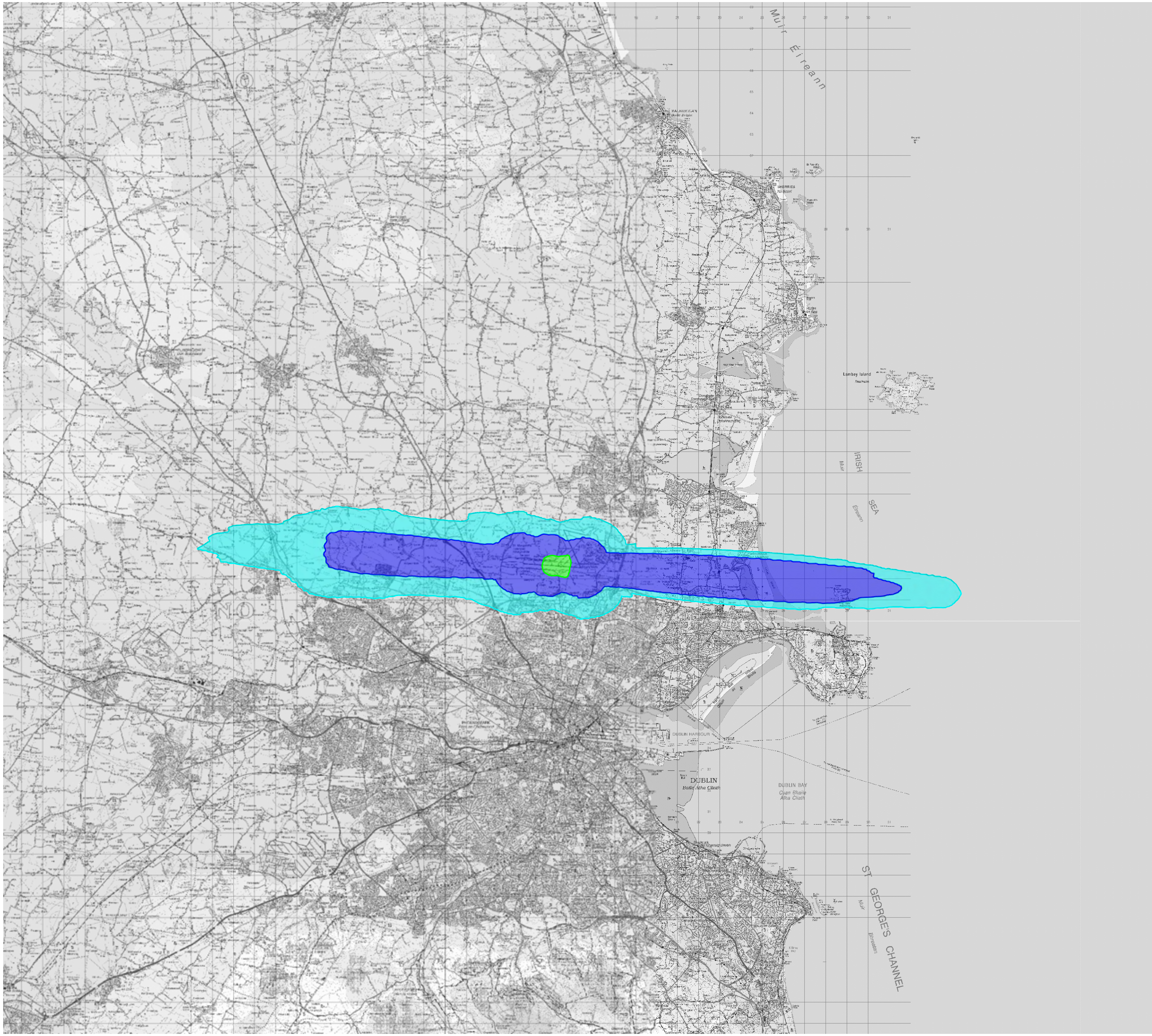

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LEGEND:

- 10 - 24 N60
- 25 - 49 N60
- 50+ N60

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Figure 13C-30

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DATE: July 2021 SCALE: 1:250000@A4

Drawing No:

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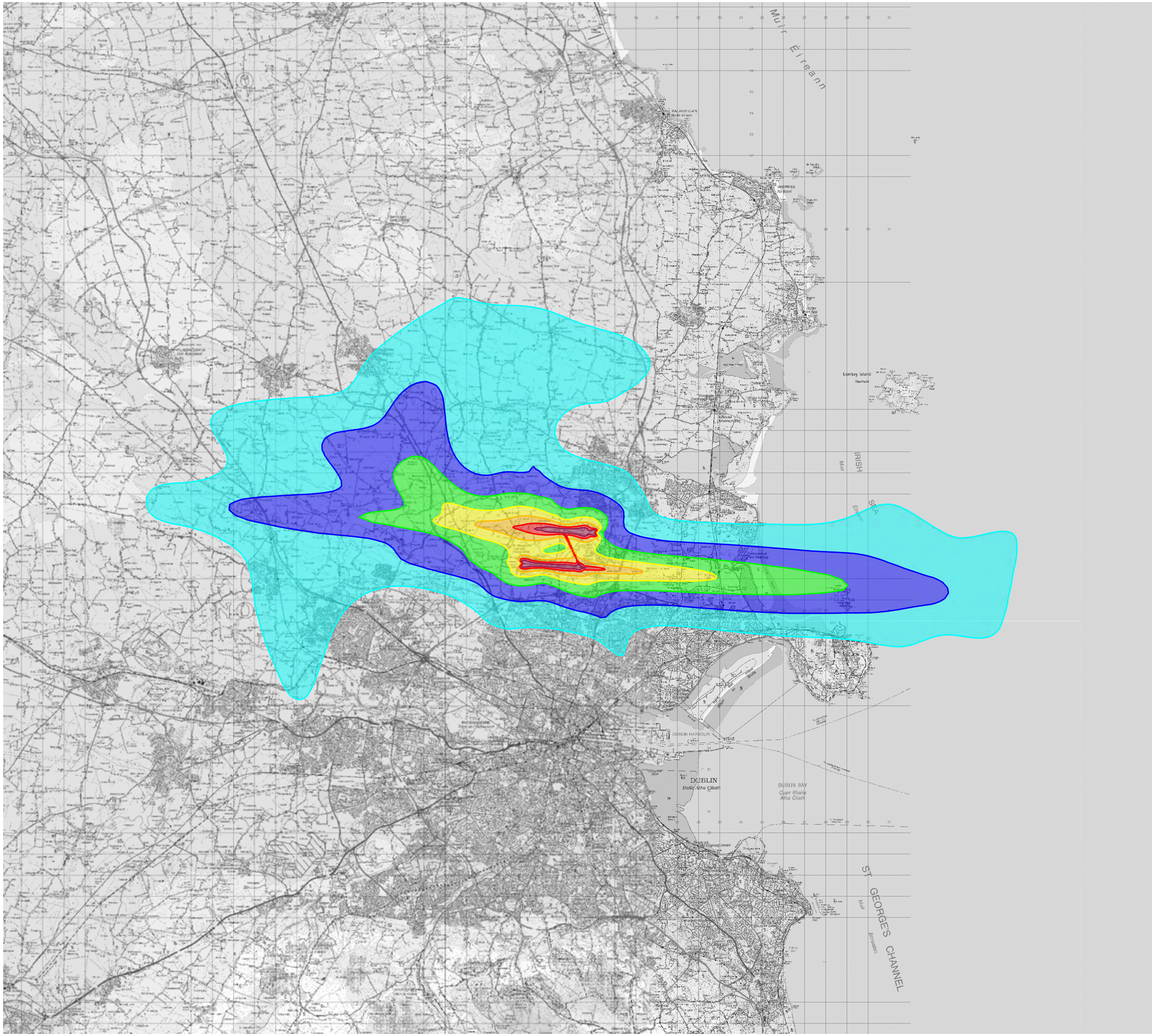

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LEGEND:

- 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}

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Figure 13C-31

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DATE: July 2021 SCALE: 1:250000@A4

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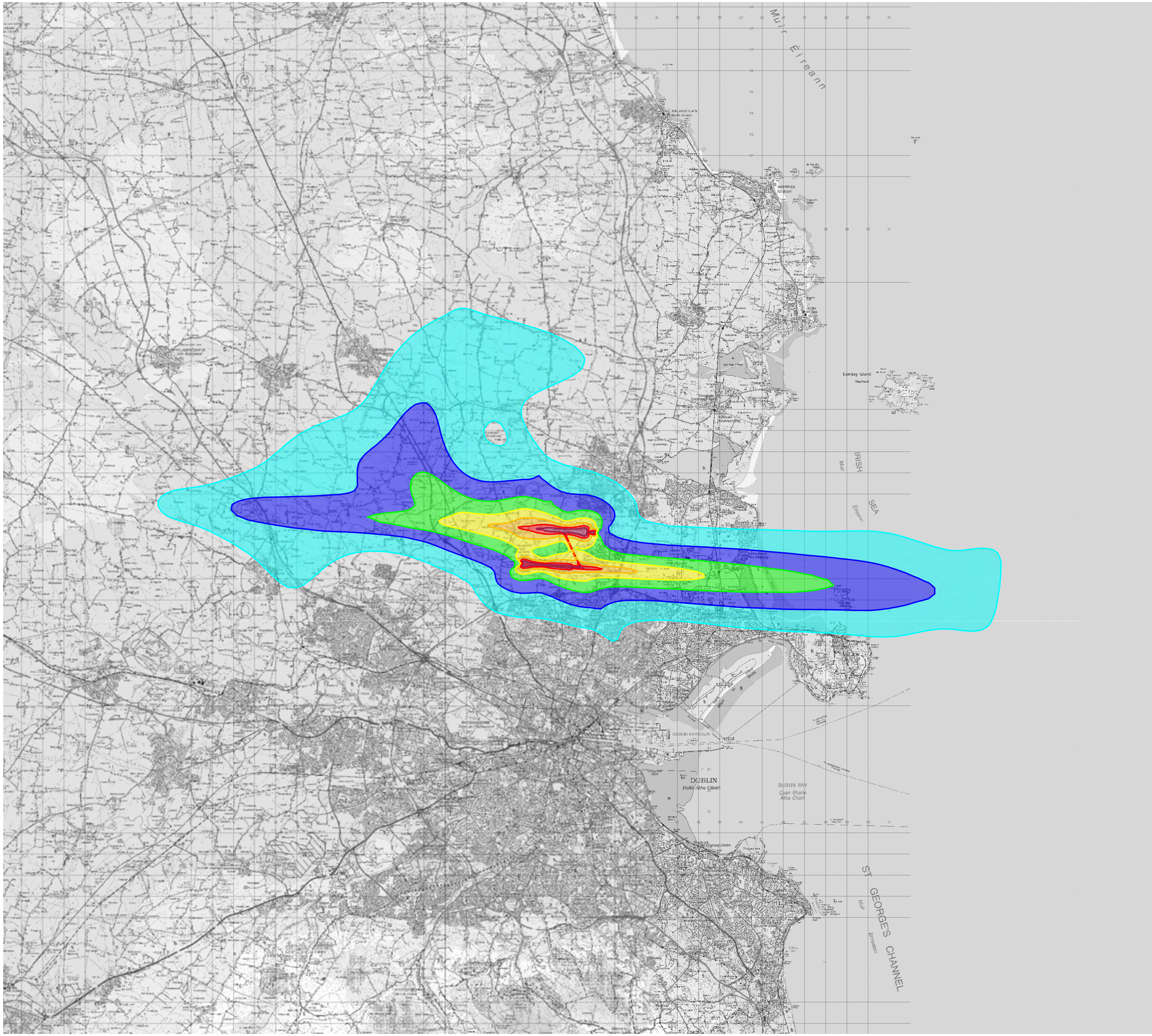

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LEGEND:

- 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) $L_{evening}$

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2025 Permitted Scenario
Figure 13C-32

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DATE: July 2021 SCALE: 1:250000@A4

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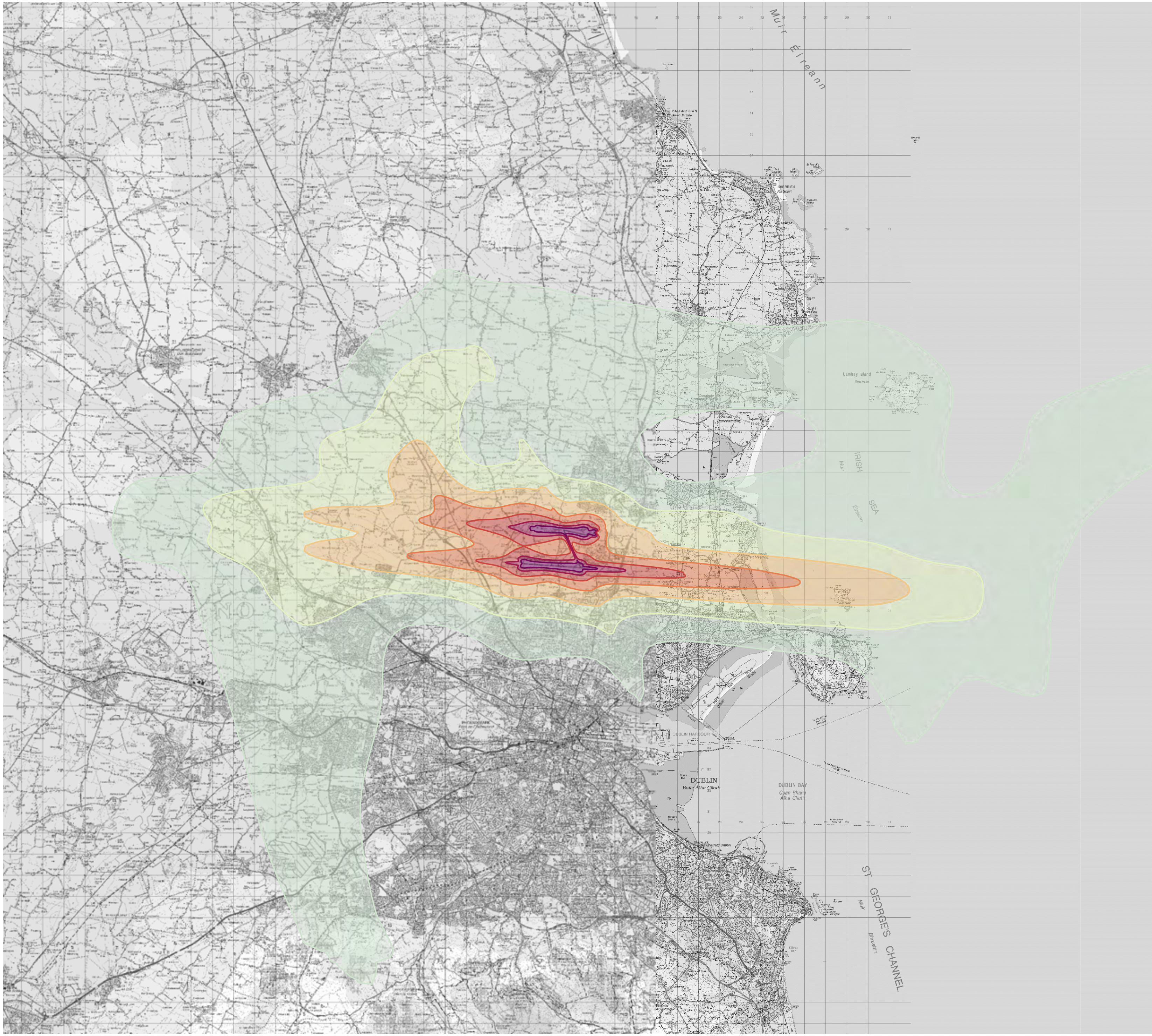

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LEGEND:

- 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 13C-33

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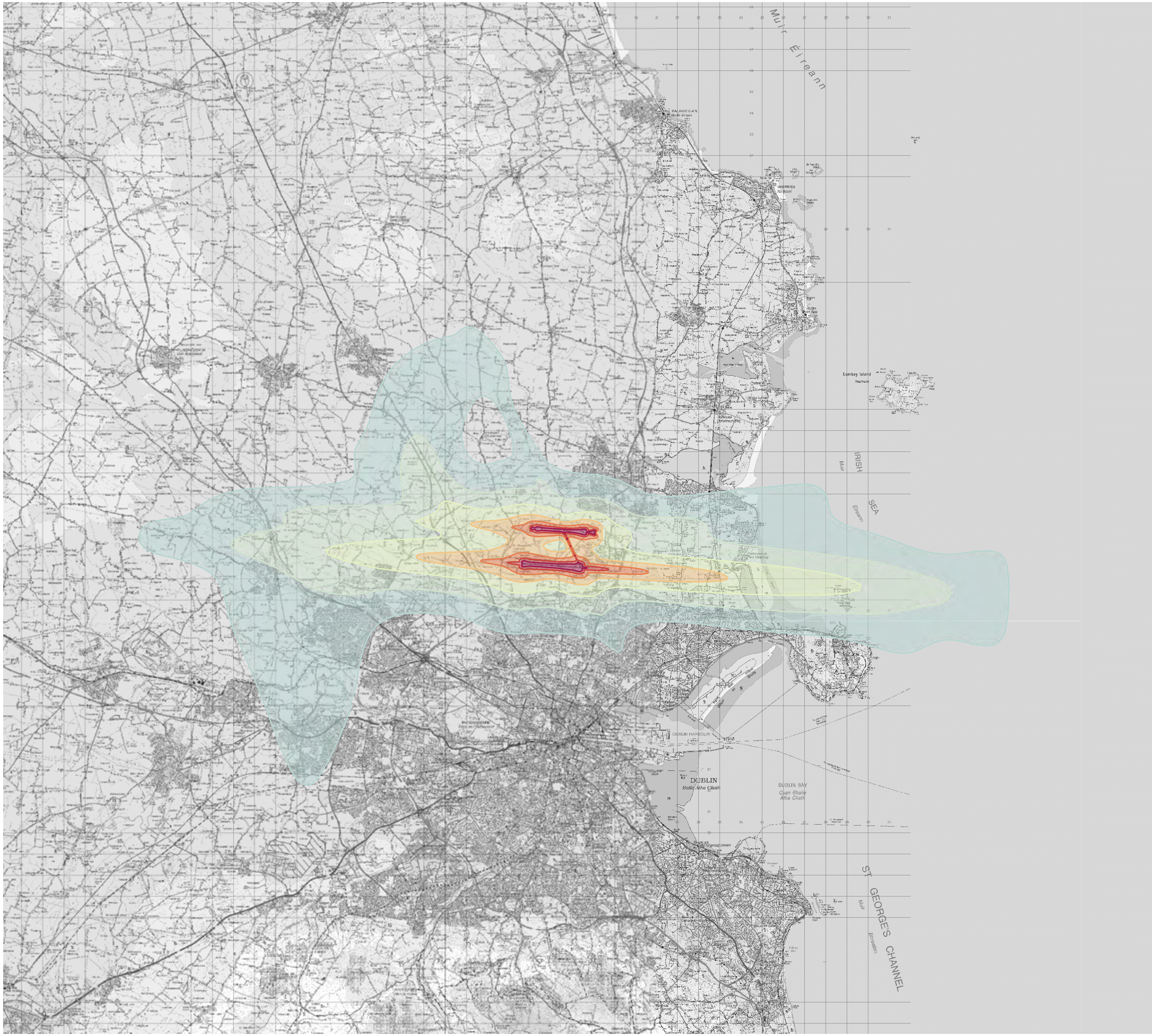

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LEGEND:

- 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 13C-34

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SCALE: 1:250000@A4

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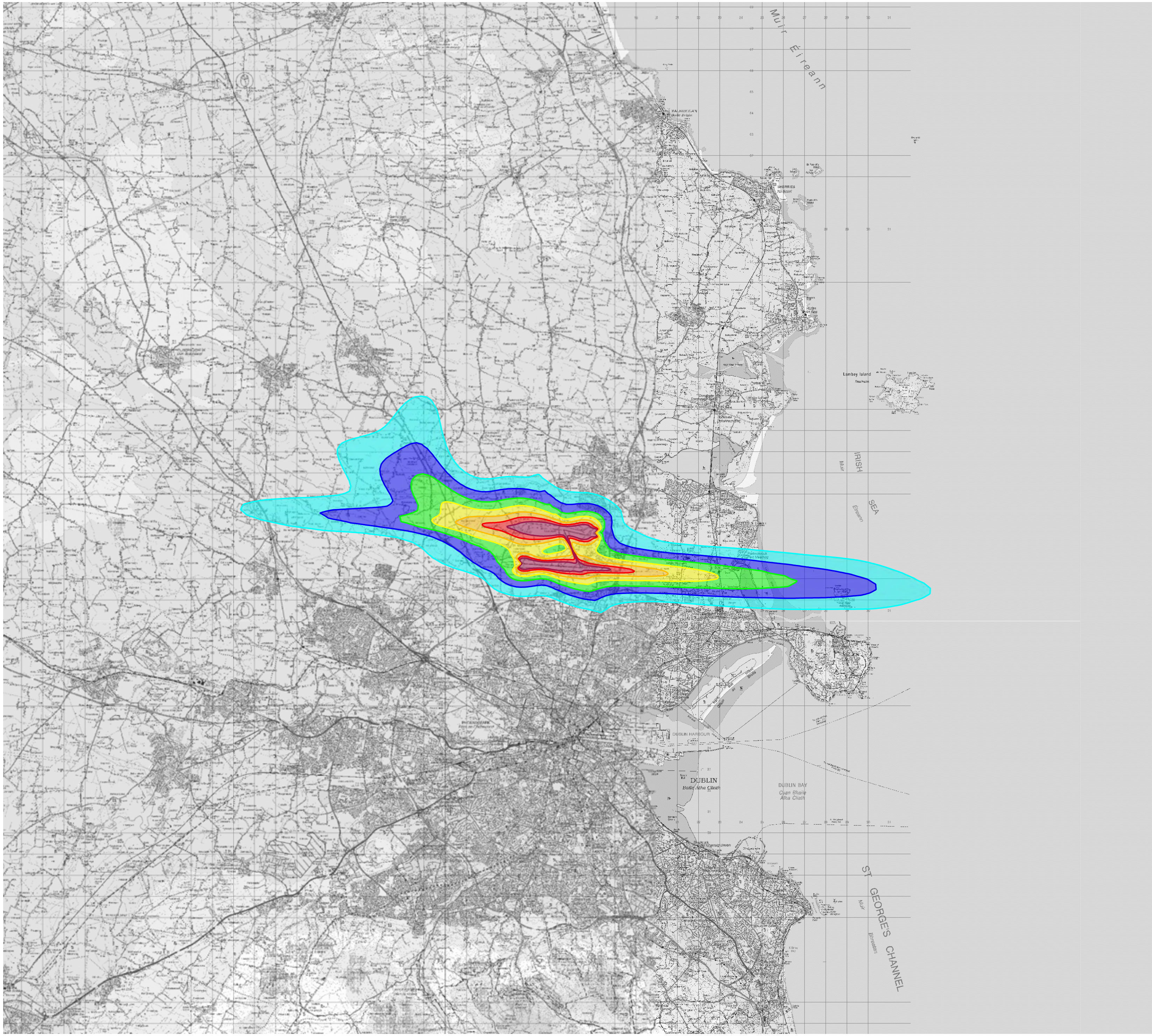

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LEGEND:

- 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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2025 Proposed Scenario
Figure 13C-35

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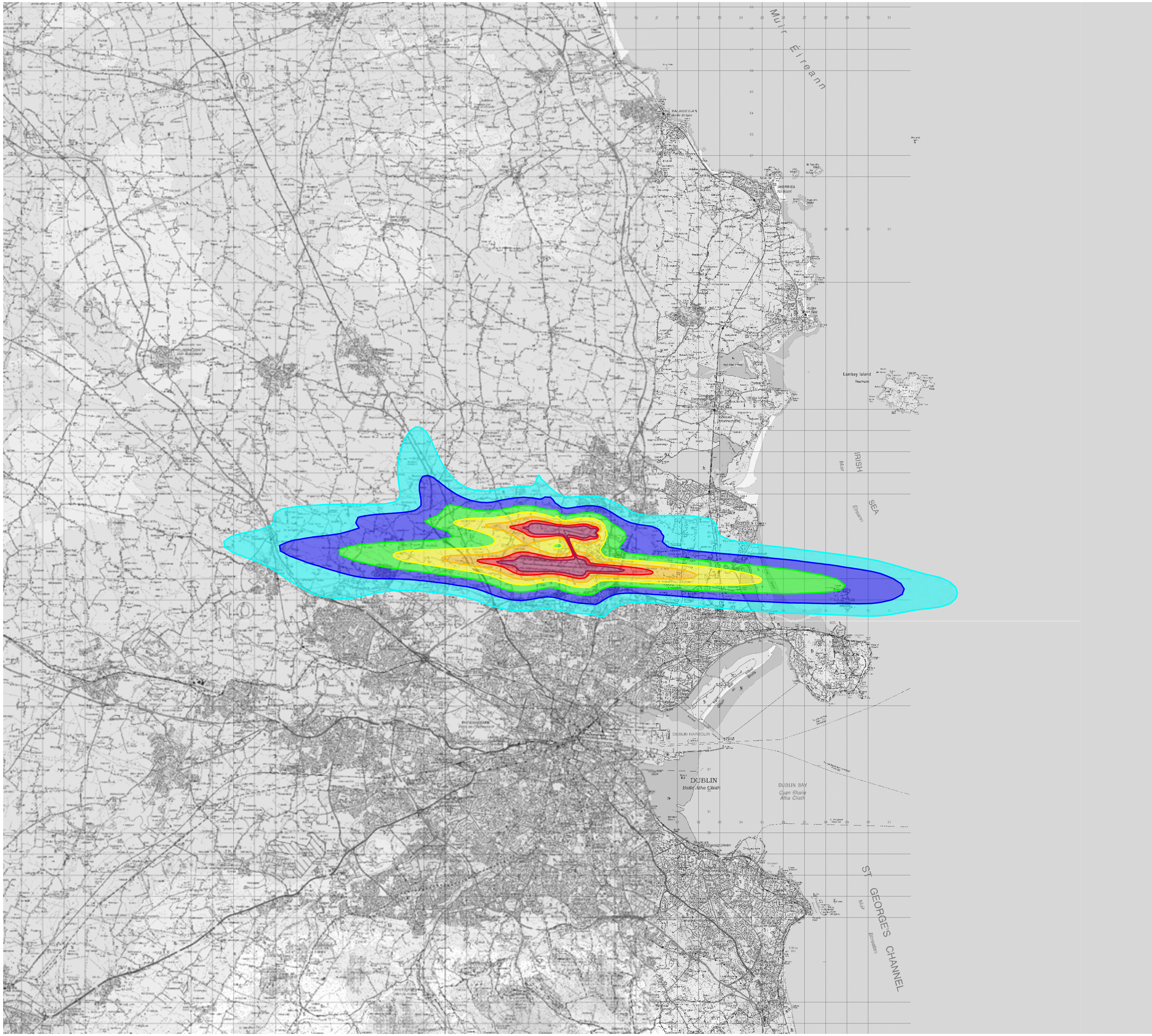

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LEGEND:

- 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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2025 Proposed Scenario
Figure 13C-36

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Drawing No:

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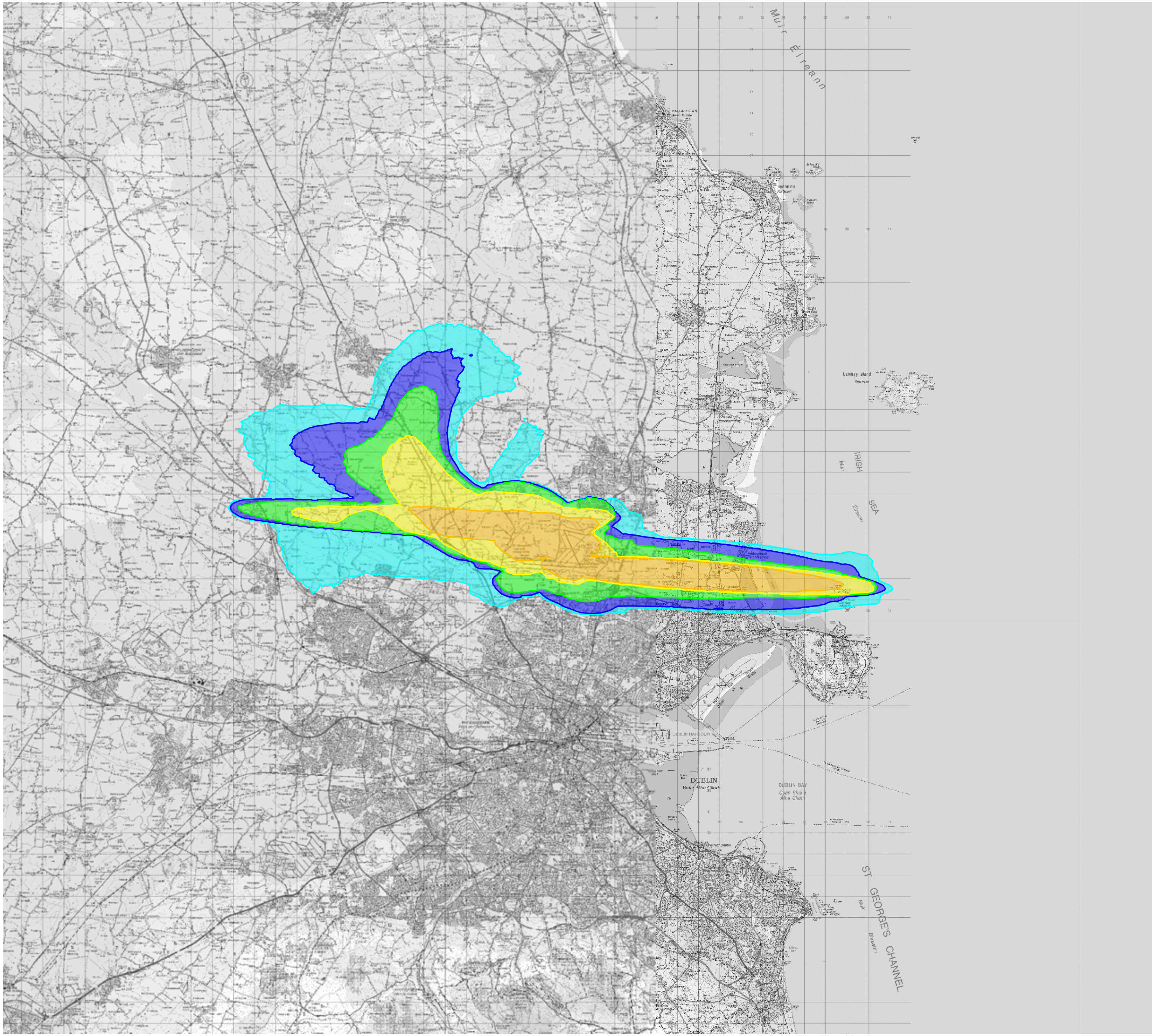

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LEGEND:

- 10 - 24 N65
- 25 - 49 N65
- 50 - 99 N65
- 100 - 199 N65
- 200 - 499 N65
- 500+ N65

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Figure 13C-37

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DATE: July 2021 | SCALE: 1:250000@A4

Drawing No:

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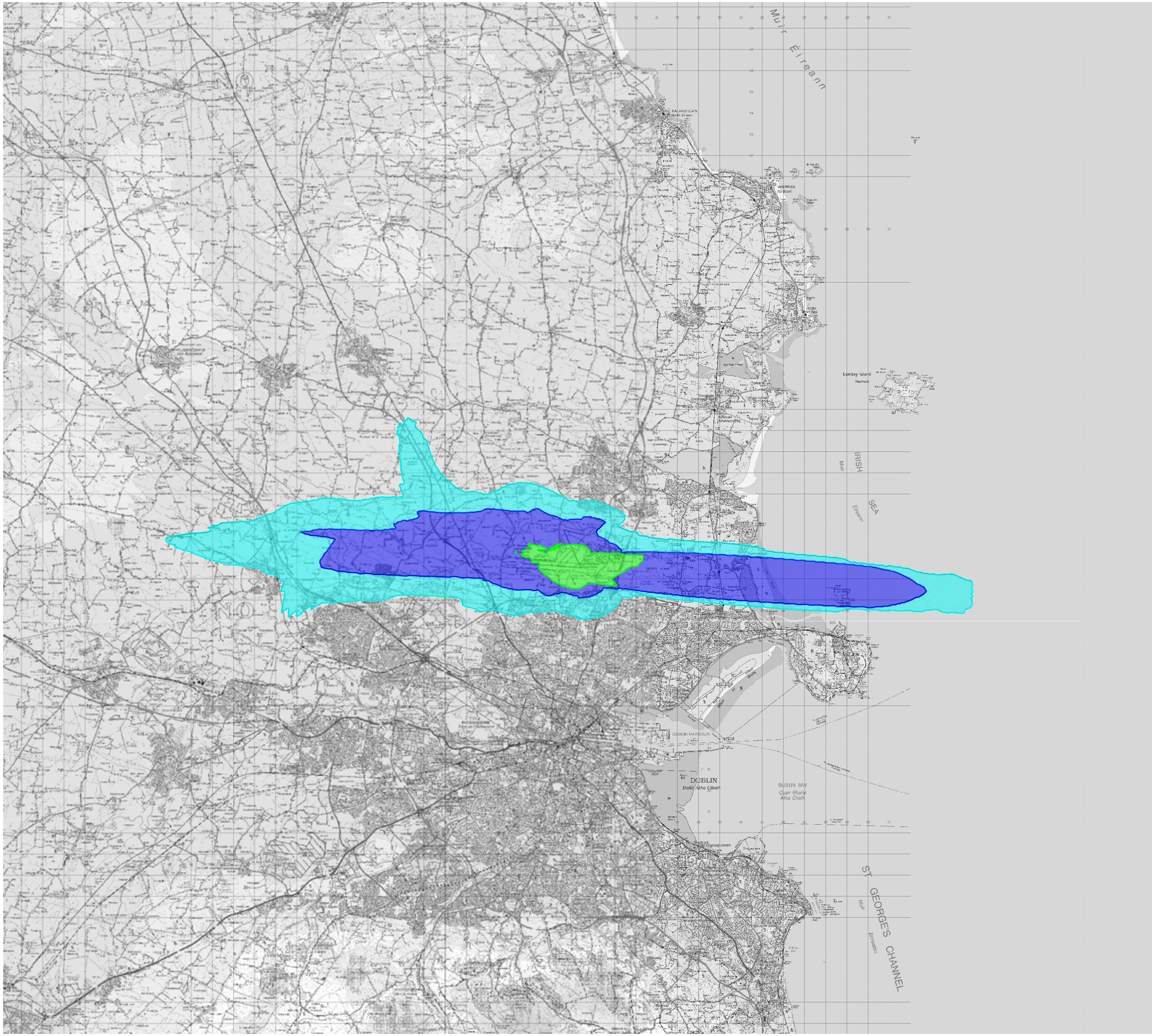

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LEGEND:

- 10 - 24 N60
- 25 - 49 N60
- 50+ N60

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Forecast N60 Noise Contours
2025 Proposed Scenario
Figure 13C-38

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DATE: July 2021
SCALE: 1:250000@A4

Drawing No:

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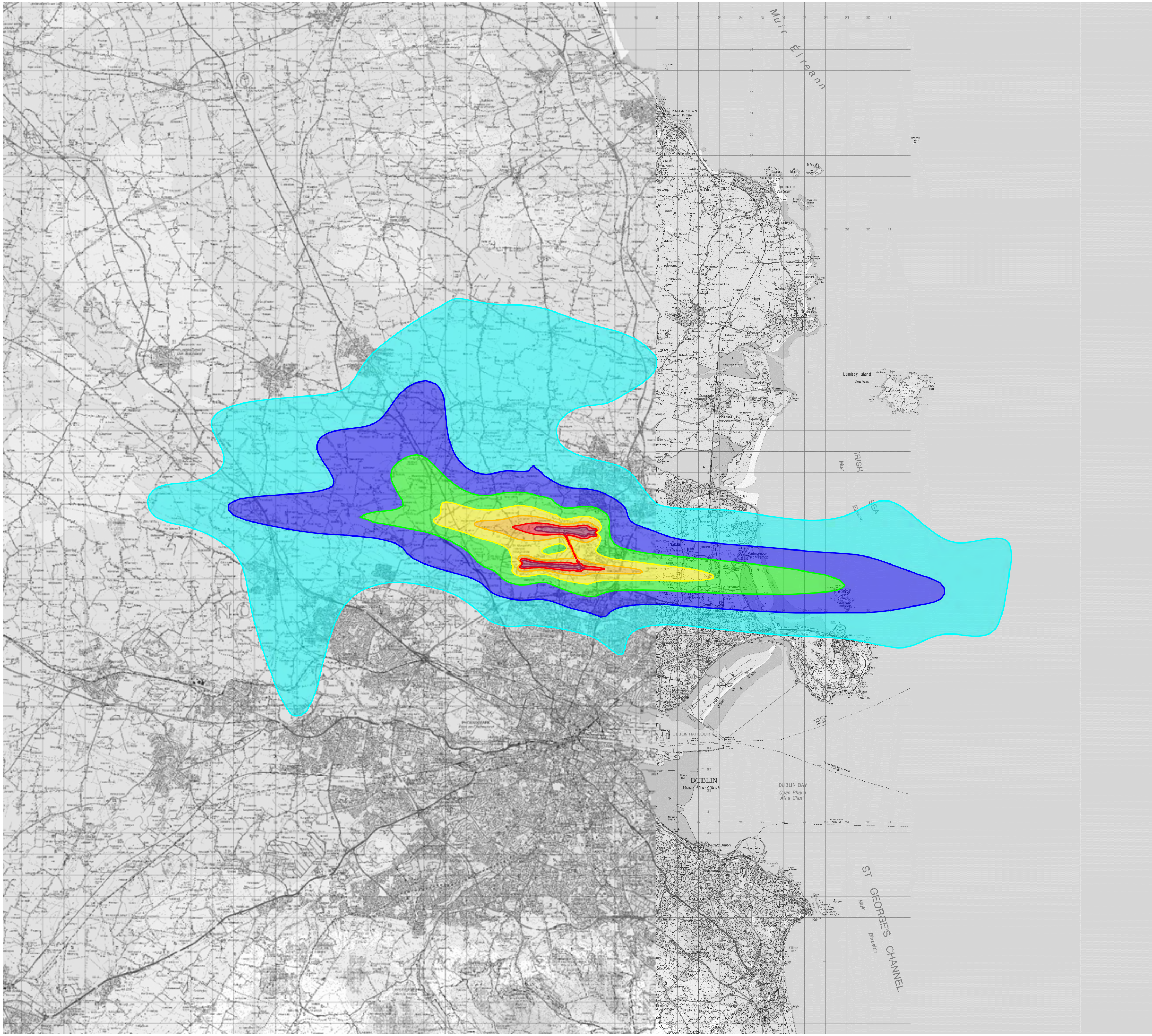

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LEGEND:

- 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}

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Figure 13C-39

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DATE: July 2021 SCALE: 1:250000@A4

Drawing No:

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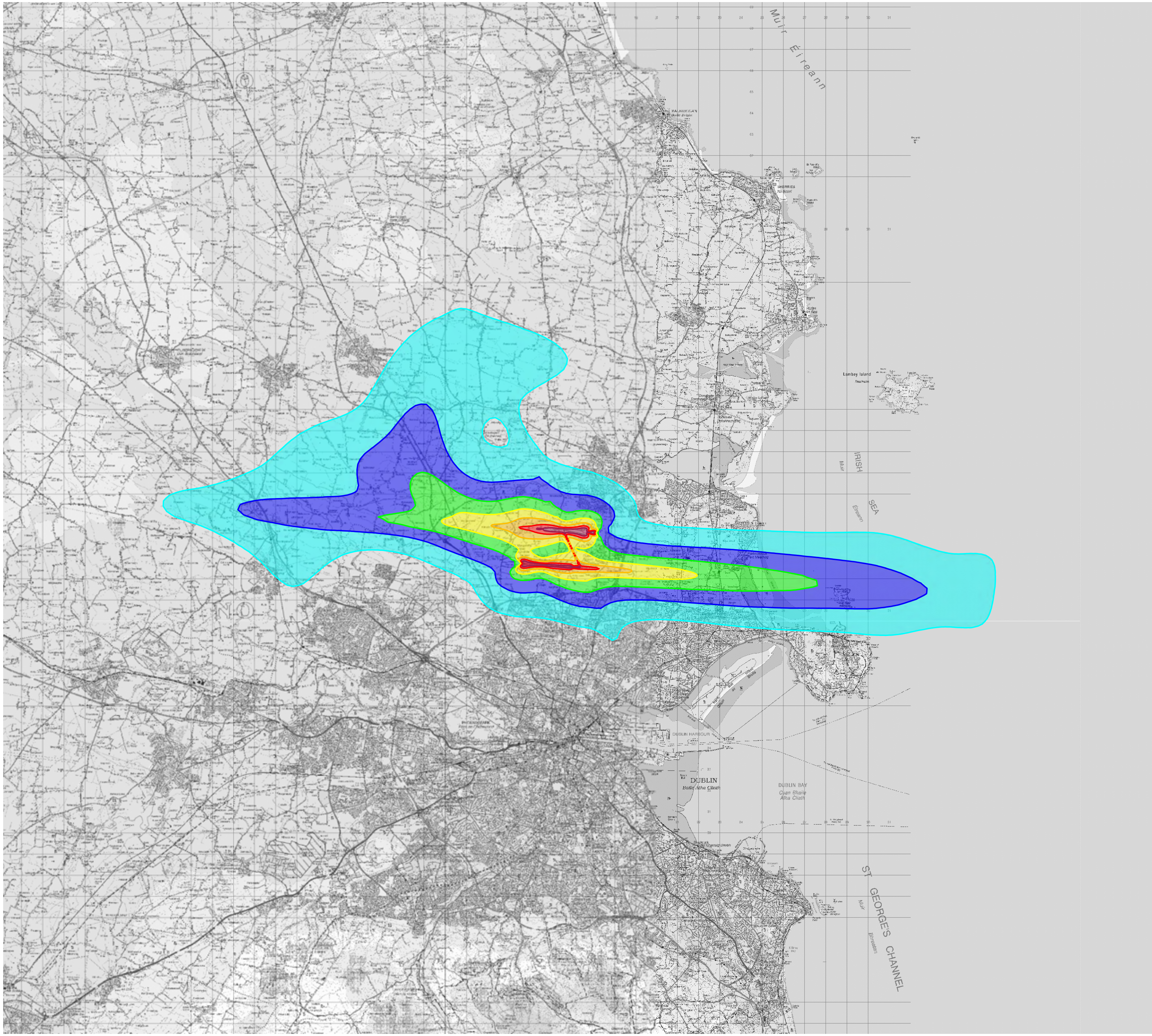

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LEGEND:

- 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) $L_{evening}$

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Forecast Levening Noise Contours
2025 Proposed Scenario
Figure 13C-40

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DATE: July 2021
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Drawing No:

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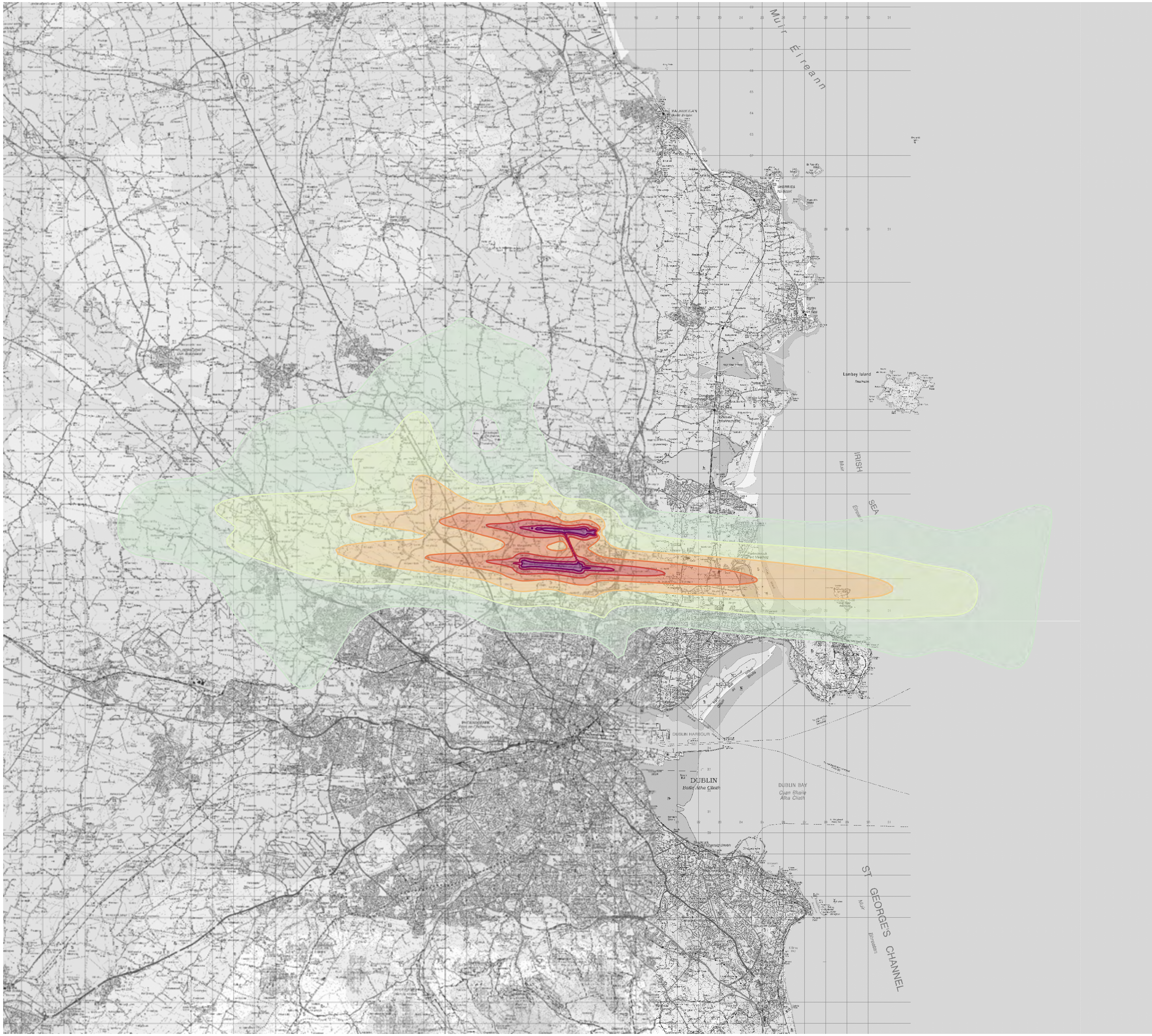

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LEGEND:

- 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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Forecast Lden Noise Contours
2035 Permitted Scenario
Figure 13C-41

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DATE: July 2021 SCALE: 1:250000@A4

Drawing No:

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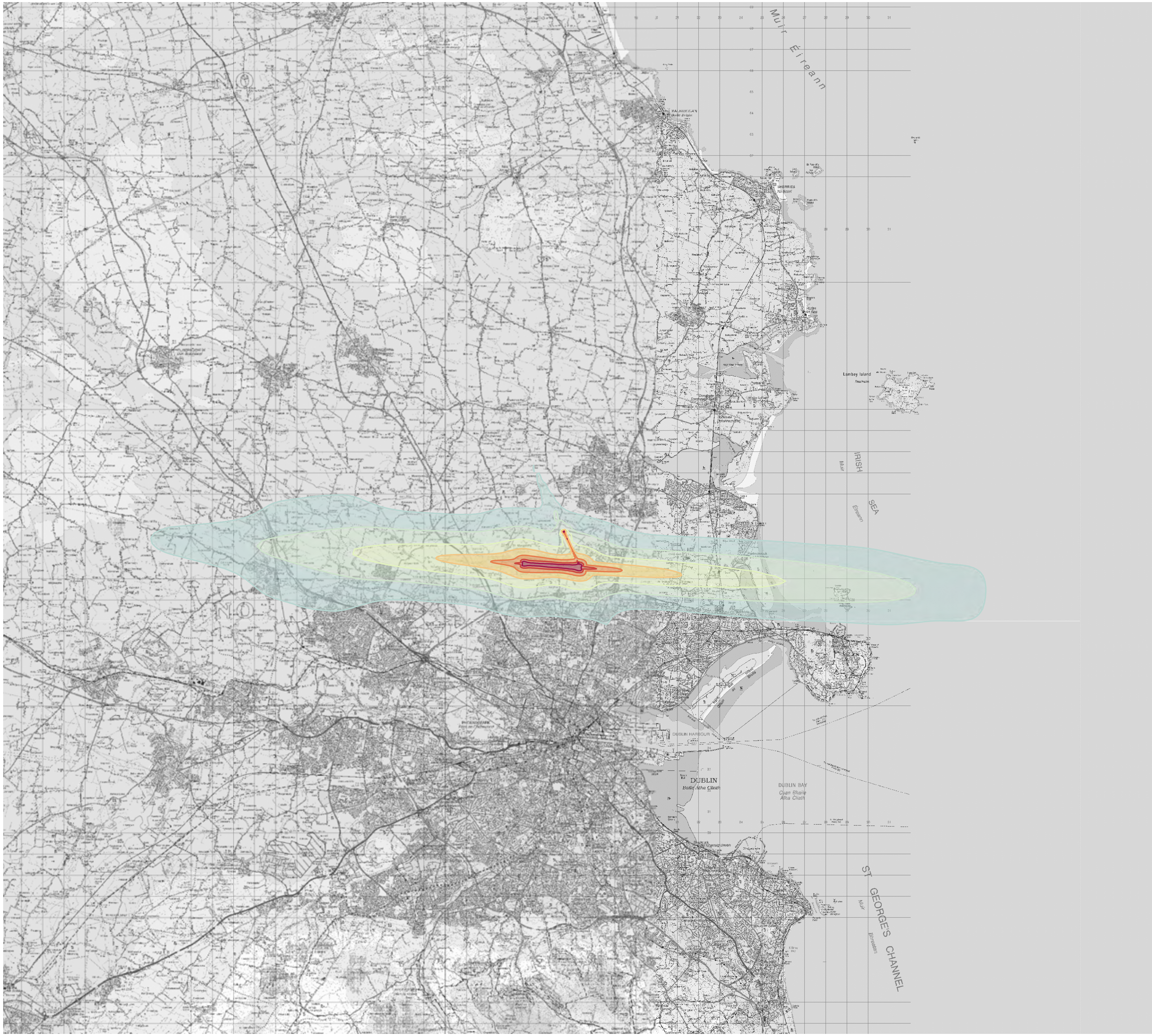

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LEGEND:

- 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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Forecast Lnight Noise Contours
2035 Permitted Scenario
Figure 13C-42

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DATE: July 2021 SCALE: 1:250000@A4

Drawing No:

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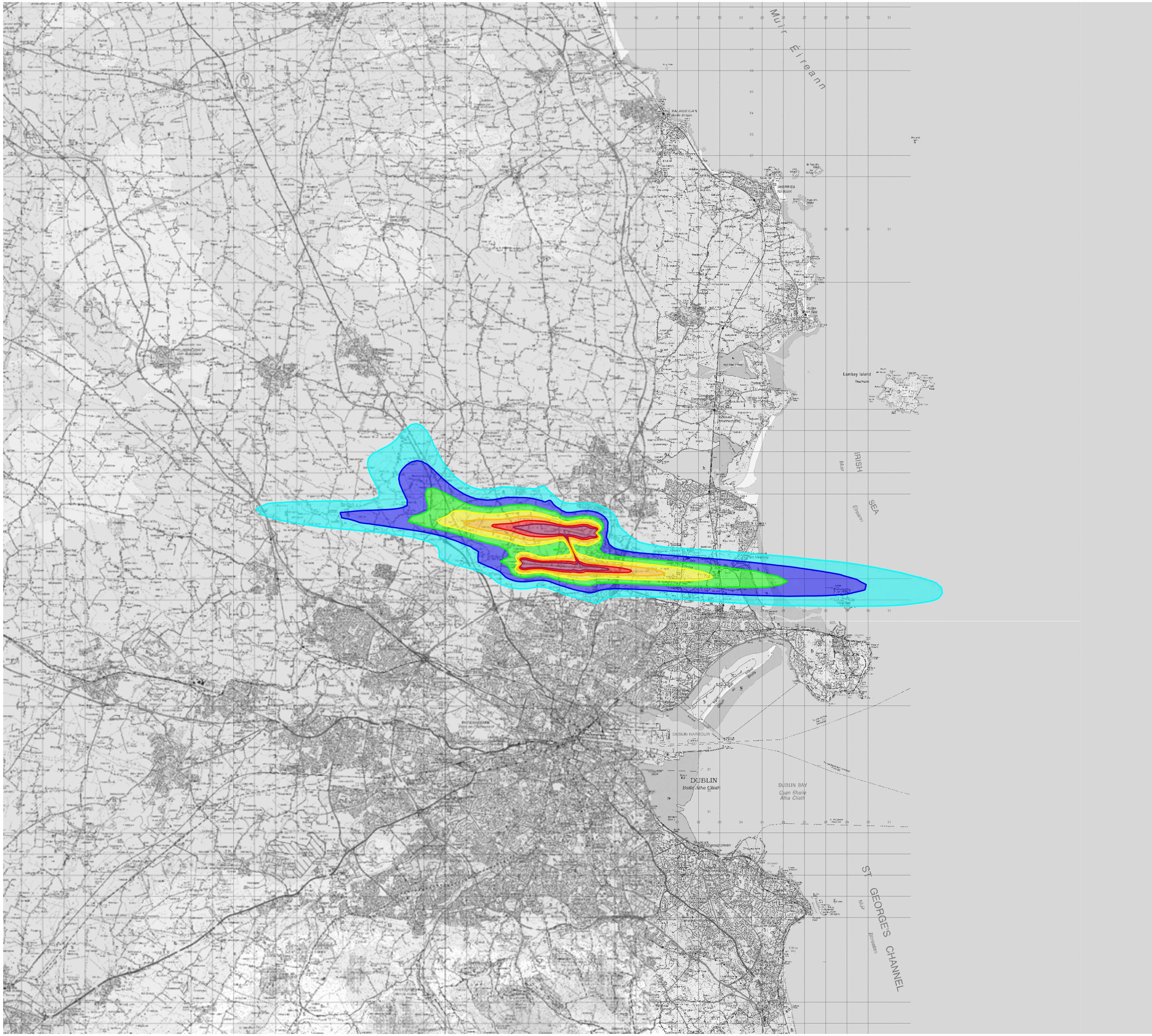

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LEGEND:

- 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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Forecast LAeq,16h Noise Contours
2035 Permitted Scenario
Figure 13C-43

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DATE: July 2021 SCALE: 1:250000@A4

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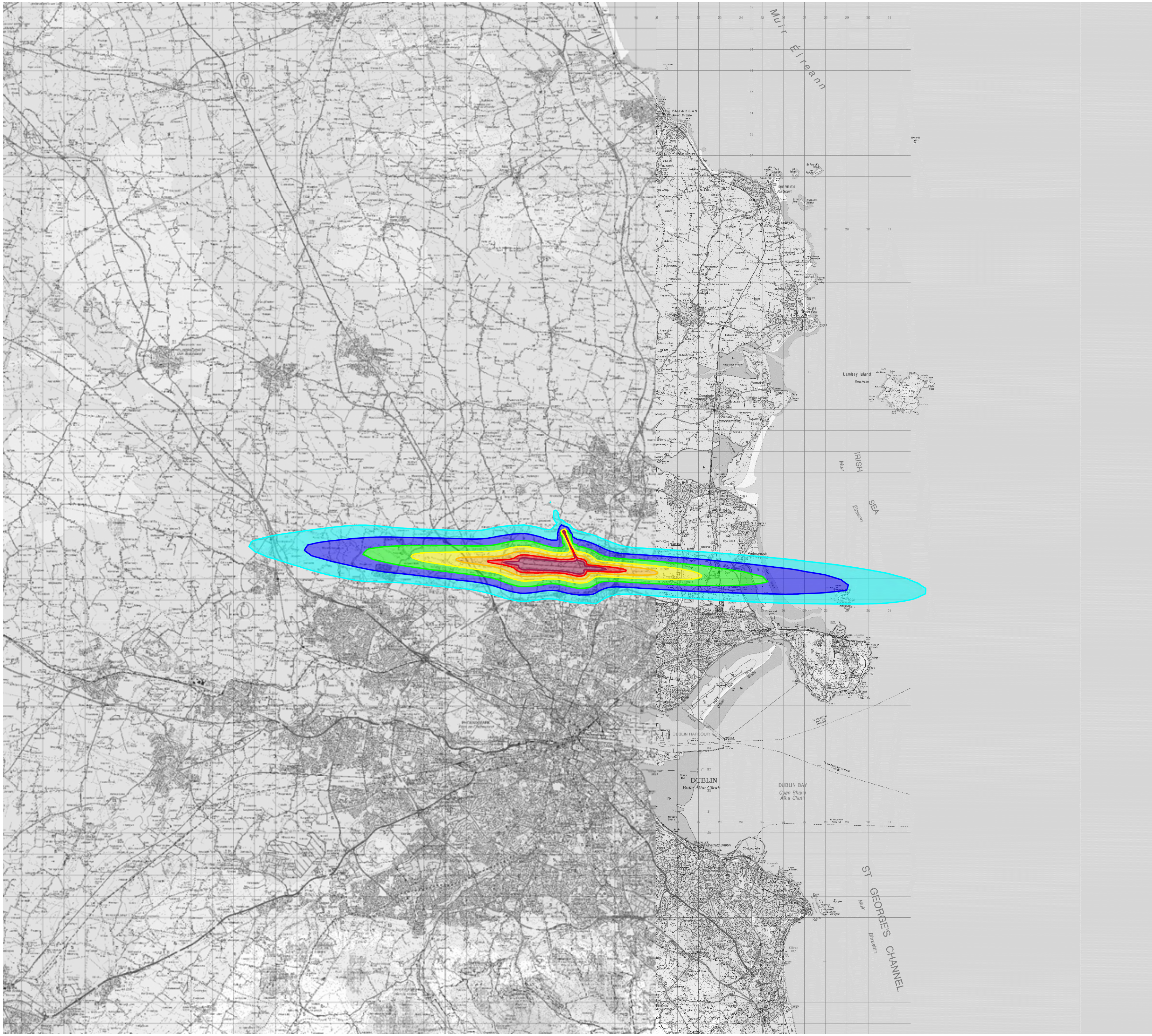

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LEGEND:

- 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 13C-44

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Drawing No:

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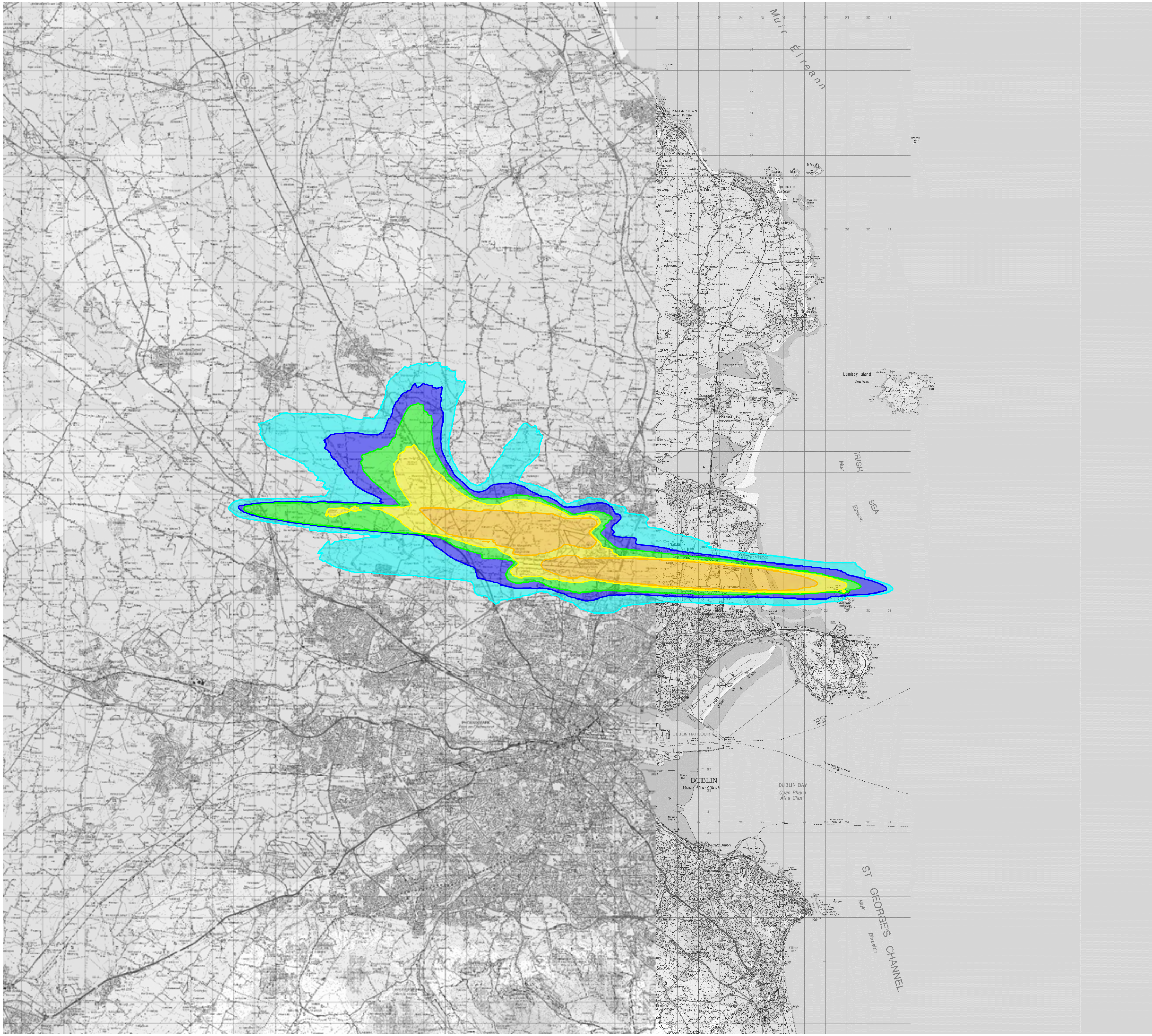

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LEGEND:

- 10 - 24 N65
- 25 - 49 N65
- 50 - 99 N65
- 100 - 199 N65
- 200 - 499 N65
- 500+ N65

Rev	Date	Description	Initials

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Forecast N65 Noise Contours
2035 Permitted Scenario
Figure 13C-45

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Drawing No:

A11267_19_DR734_2.0

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LEGEND:

- 10 - 24 N60
- 25 - 49 N60
- 50+ N60

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2035 Permitted Scenario
Figure 13C-46

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DATE: July 2021 SCALE: 1:250000@A4

Drawing No:

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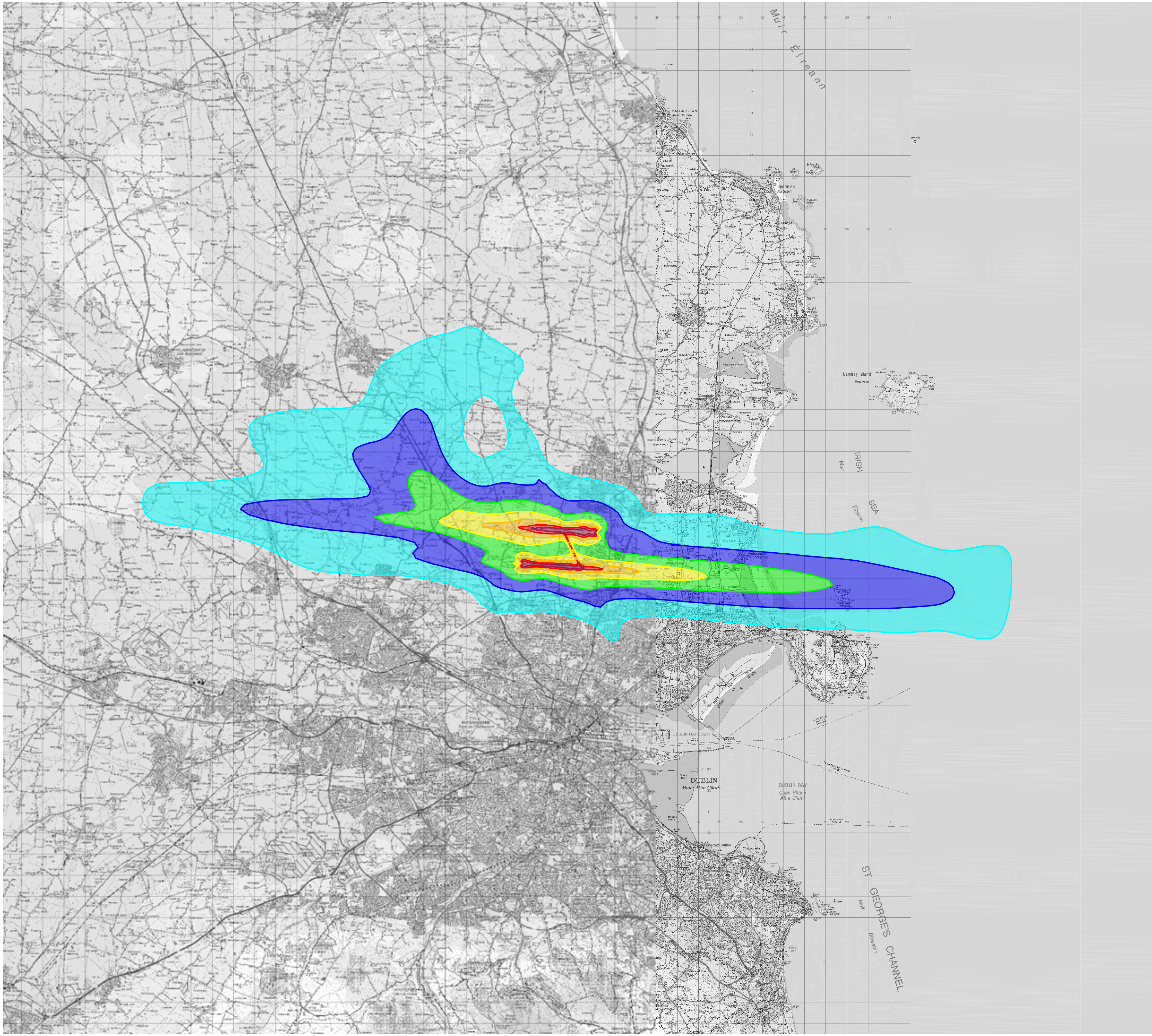

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LEGEND:

- 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}

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Figure 13C-47

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DATE: July 2021 SCALE: 1:250000@A4

Drawing No:

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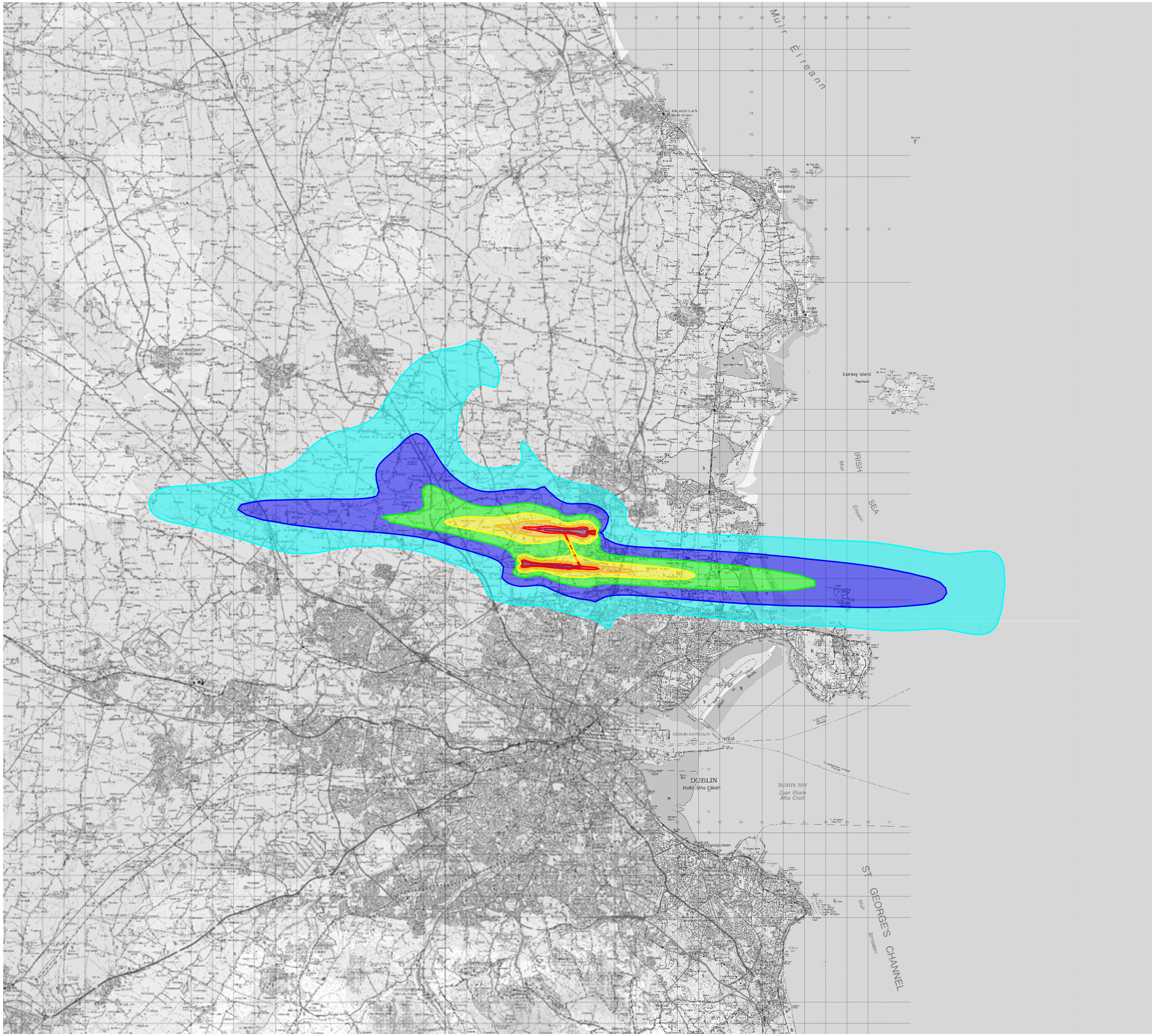

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LEGEND:

- 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) $L_{evening}$

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Forecast Levening Noise Contours
2035 Permitted Scenario
Figure 13C-48

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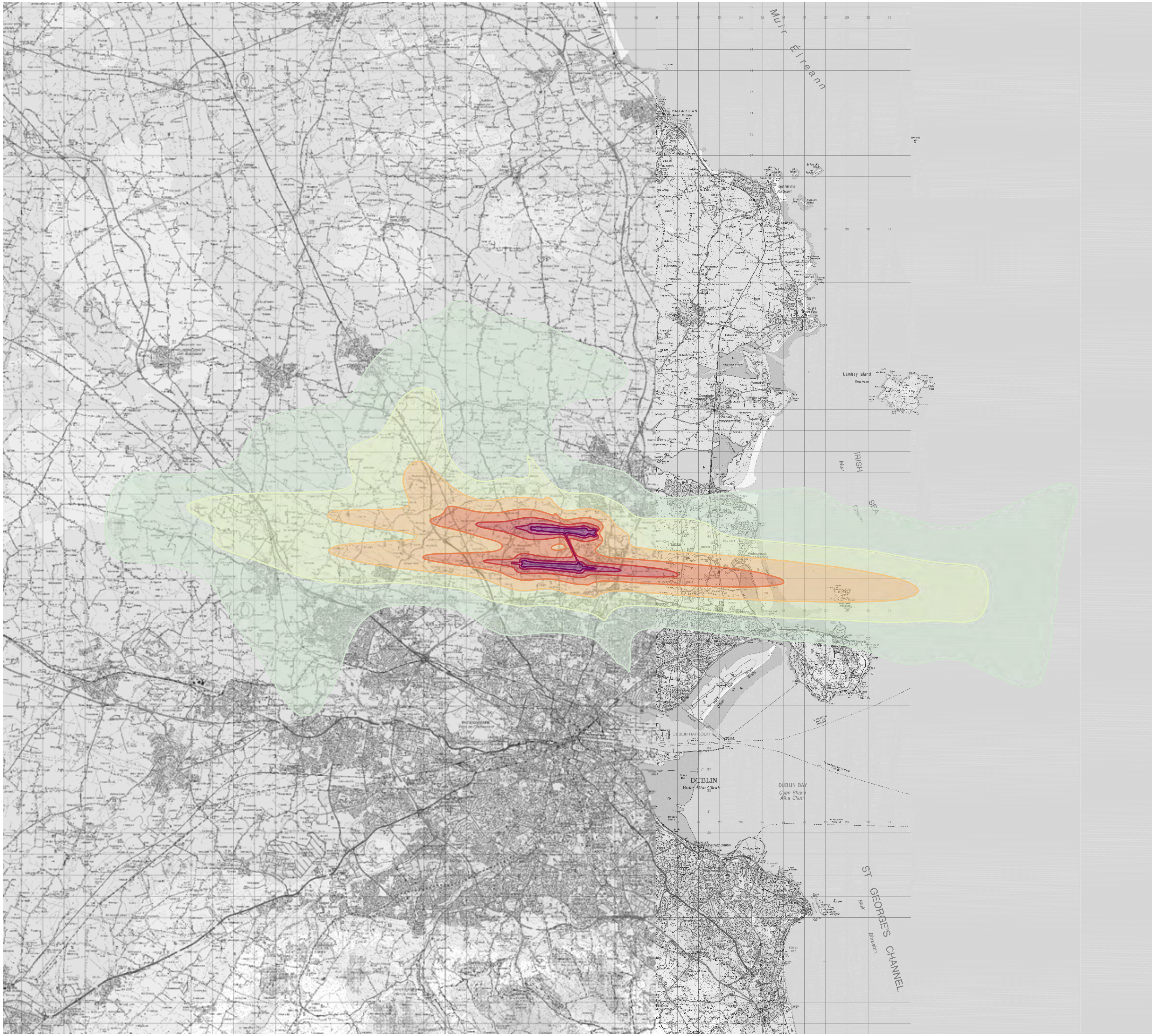
DATE: July 2021 | SCALE: 1:250000@A4

Drawing No:

A11267_19_DR737_2.0



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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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2035 Proposed Scenario
Figure 13C-49

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DATE: July 2021 SCALE: 1:250000@A4

Drawing No:

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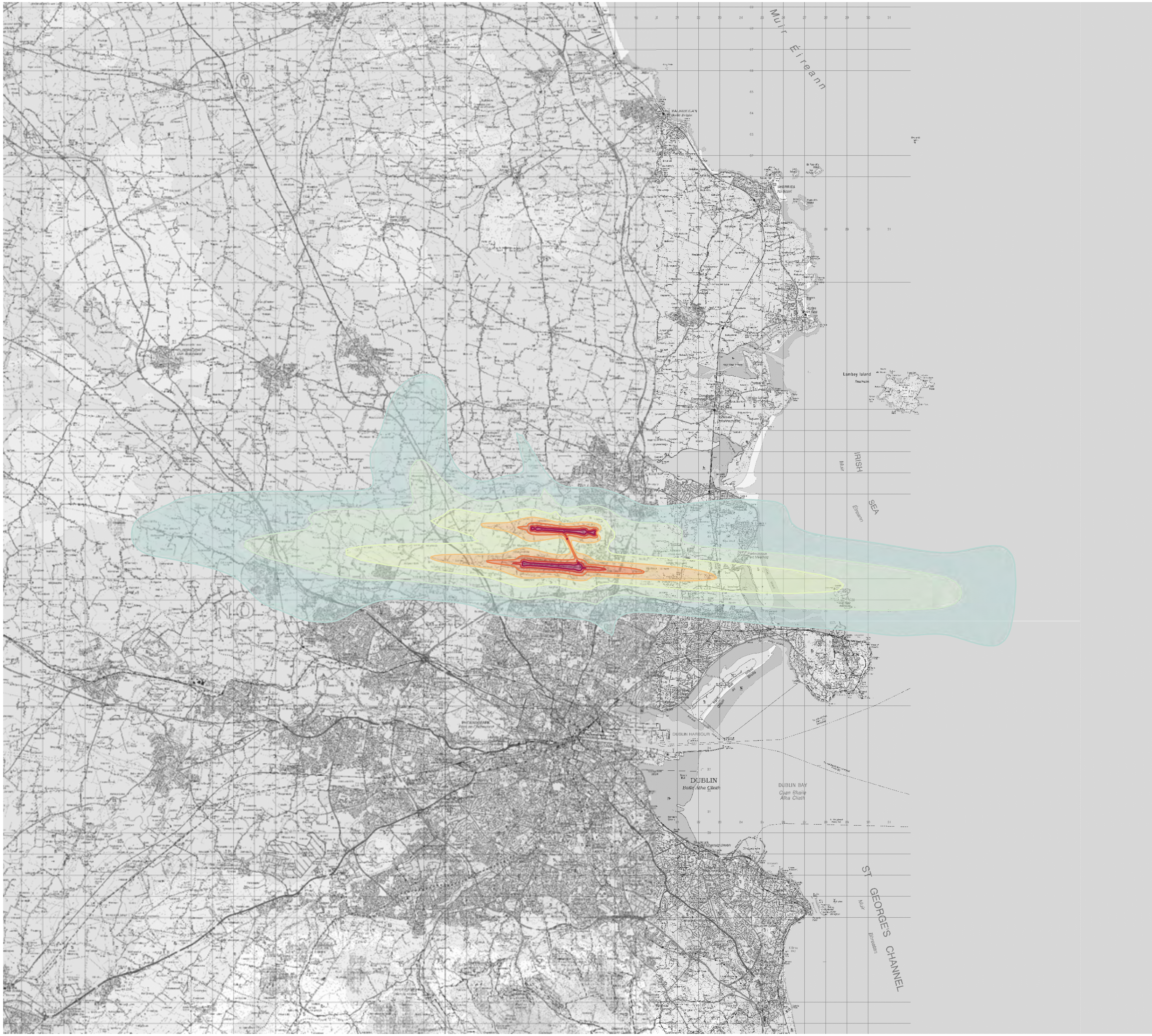

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LEGEND:

- 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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2035 Proposed Scenario
Figure 13C-50

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DATE: July 2021 SCALE: 1:250000@A4

Drawing No:

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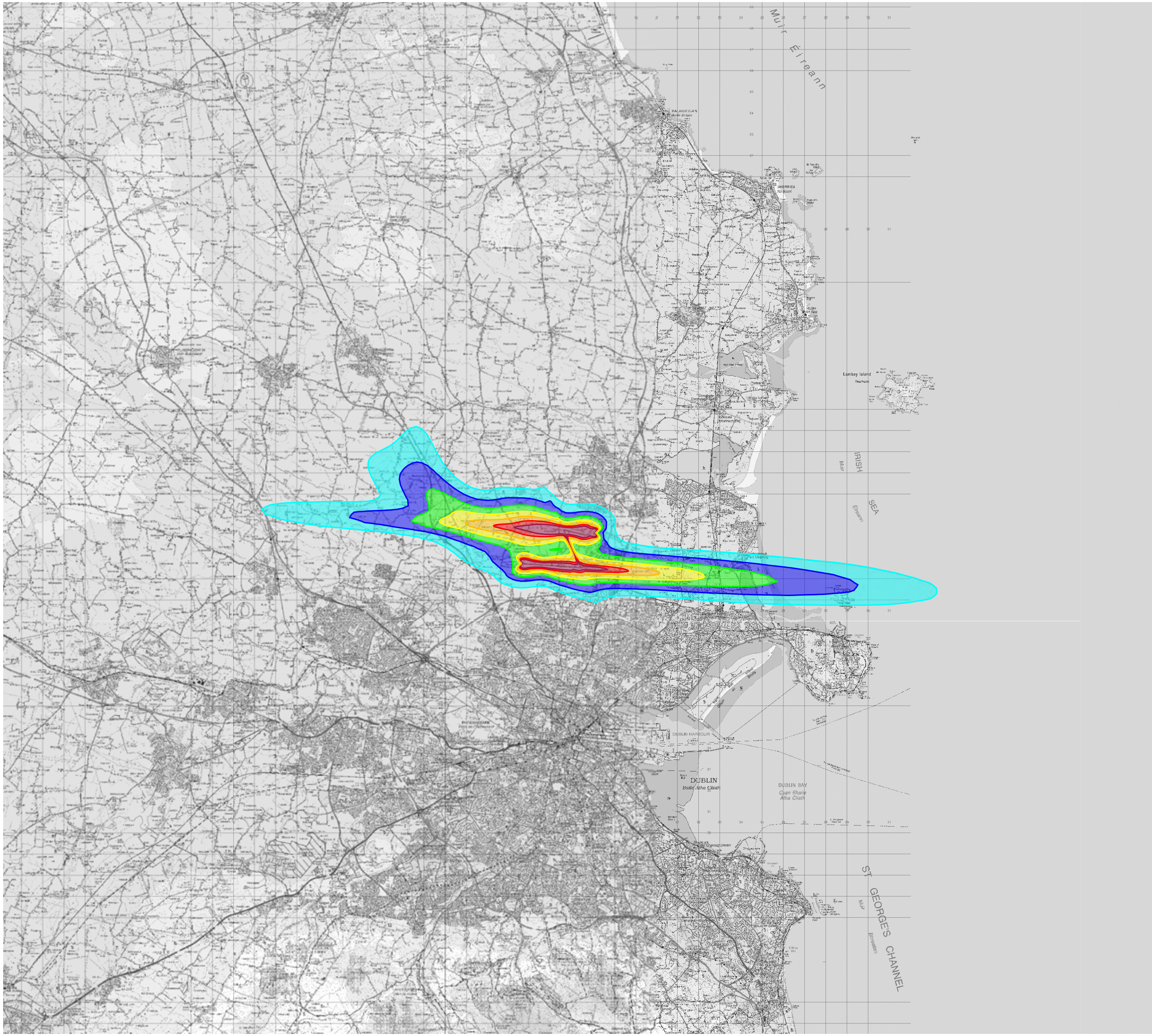

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LEGEND:

- 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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Forecast LAeq,16h Noise Contours
2035 Proposed Scenario
Figure 13C-51

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DATE: July 2021
SCALE: 1:250000@A4

Drawing No:

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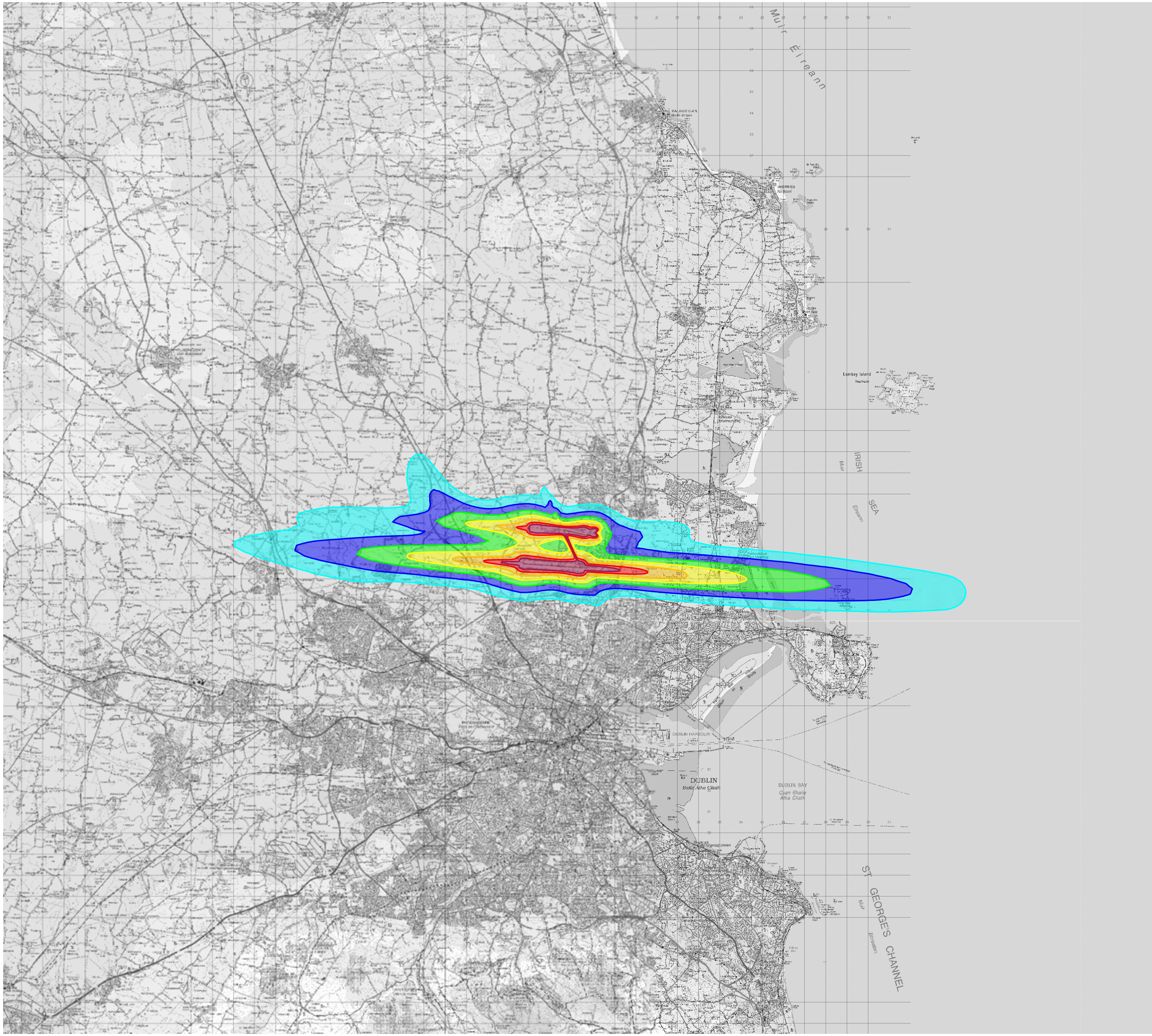

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LEGEND:

- 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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Forecast LAeq,8h Noise Contours
2035 Proposed Scenario
Figure 13C-52

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DATE: July 2021 SCALE: 1:250000@A4

Drawing No:

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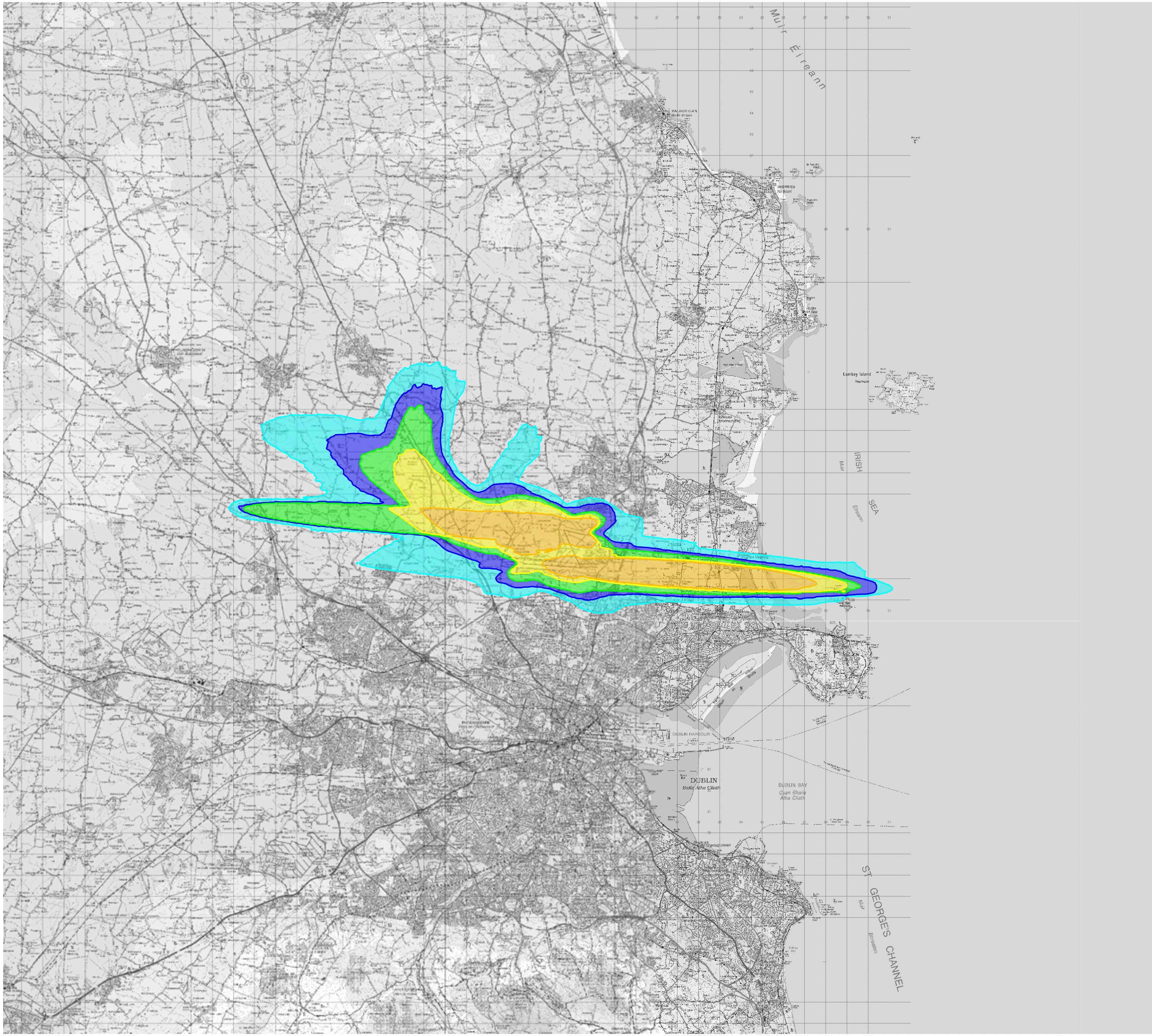

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LEGEND:

- 10 - 24 N65
- 25 - 49 N65
- 50 - 99 N65
- 100 - 199 N65
- 200 - 499 N65
- 500+ N65

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Forecast N65 Noise Contours
2035 Proposed Scenario
Figure 13C-53

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DATE: July 2021
SCALE: 1:250000@A4

Drawing No:

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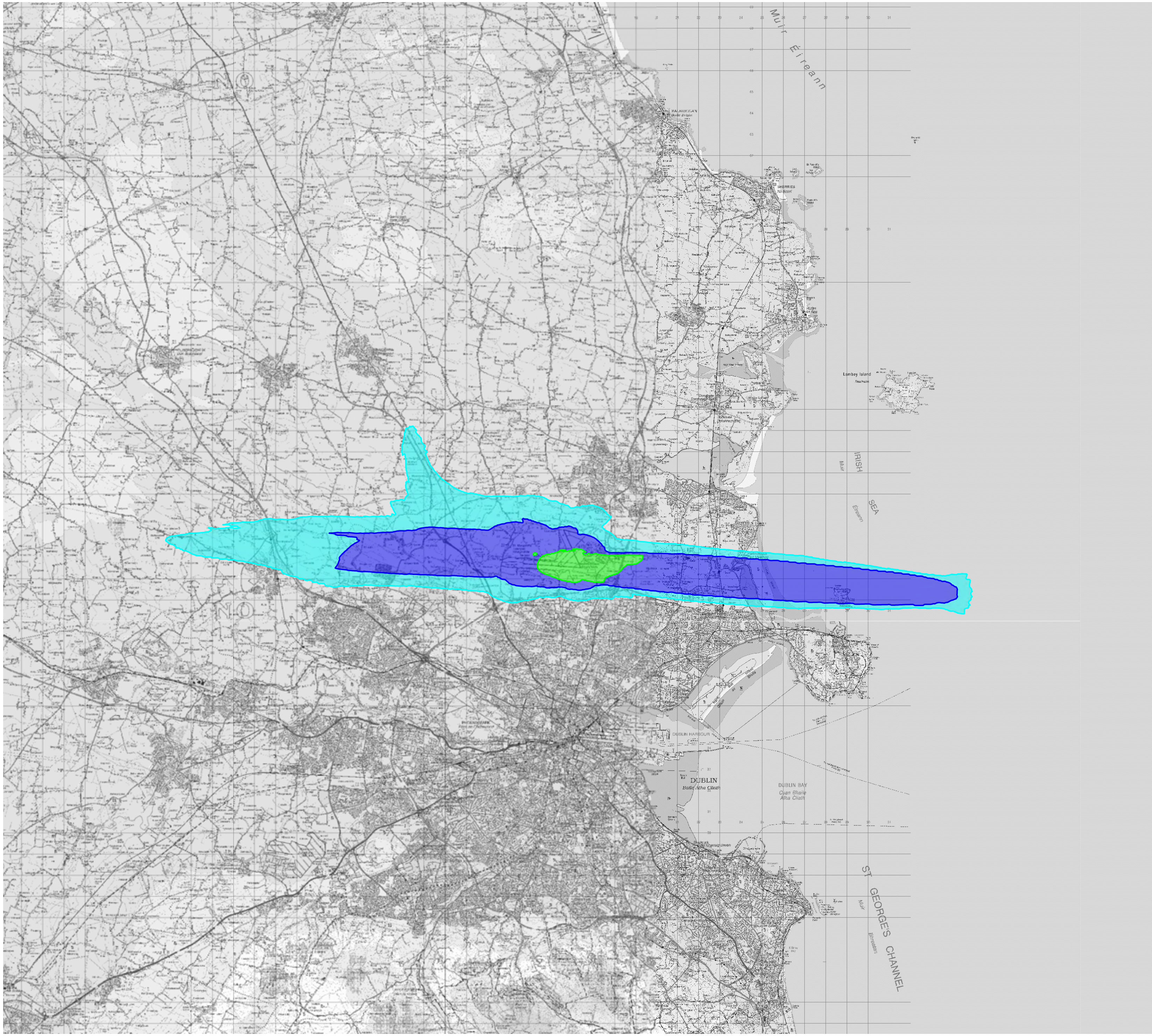

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LEGEND:

- 10 - 24 N60
- 25 - 49 N60
- 50+ N60

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2035 Proposed Scenario
Figure 13C-54

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DATE: July 2021 SCALE: 1:250000@A4

Drawing No:

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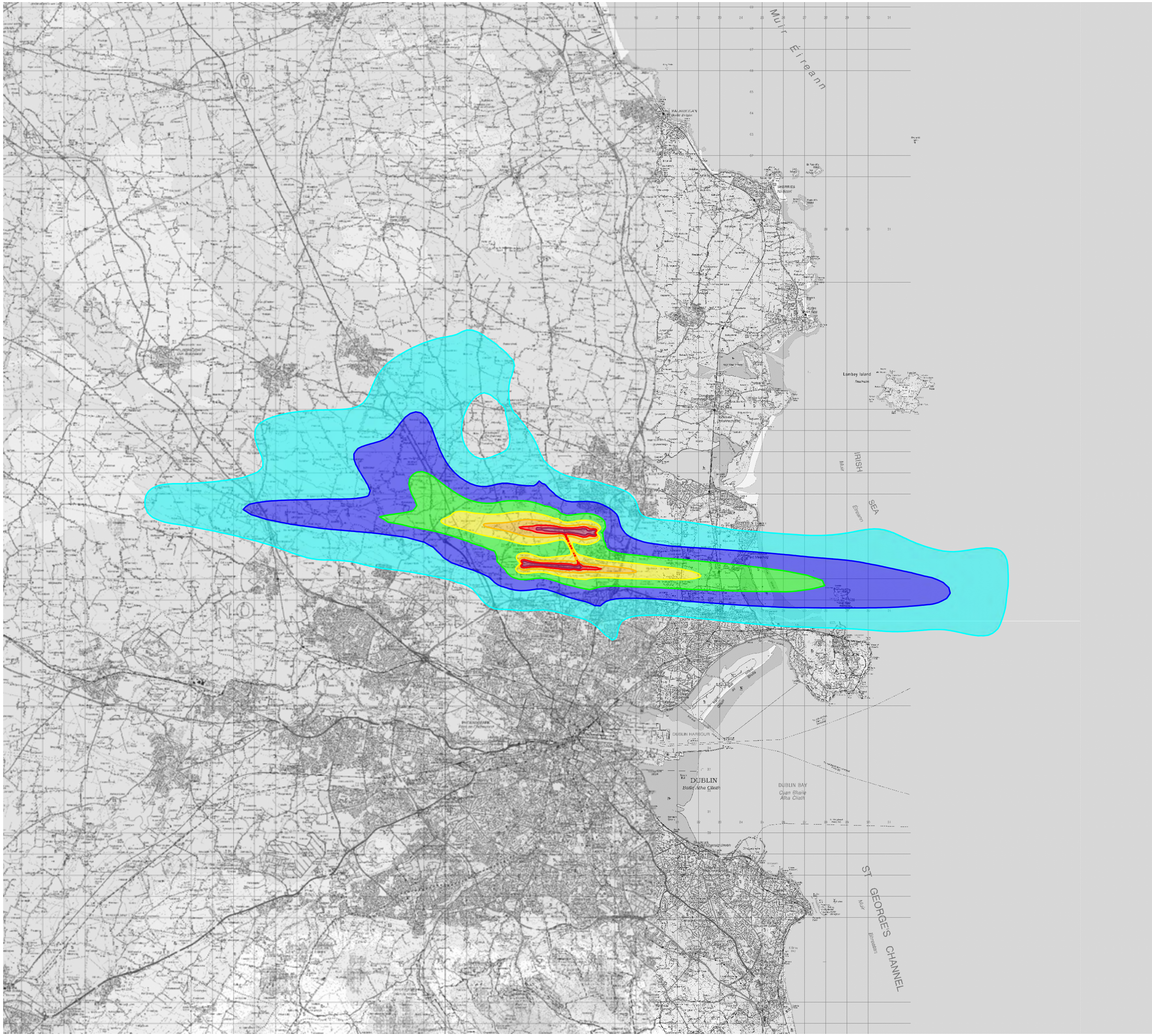

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LEGEND:

- 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}

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2035 Proposed Scenario
Figure 13C-55

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DATE: July 2021 SCALE: 1:250000@A4

Drawing No:

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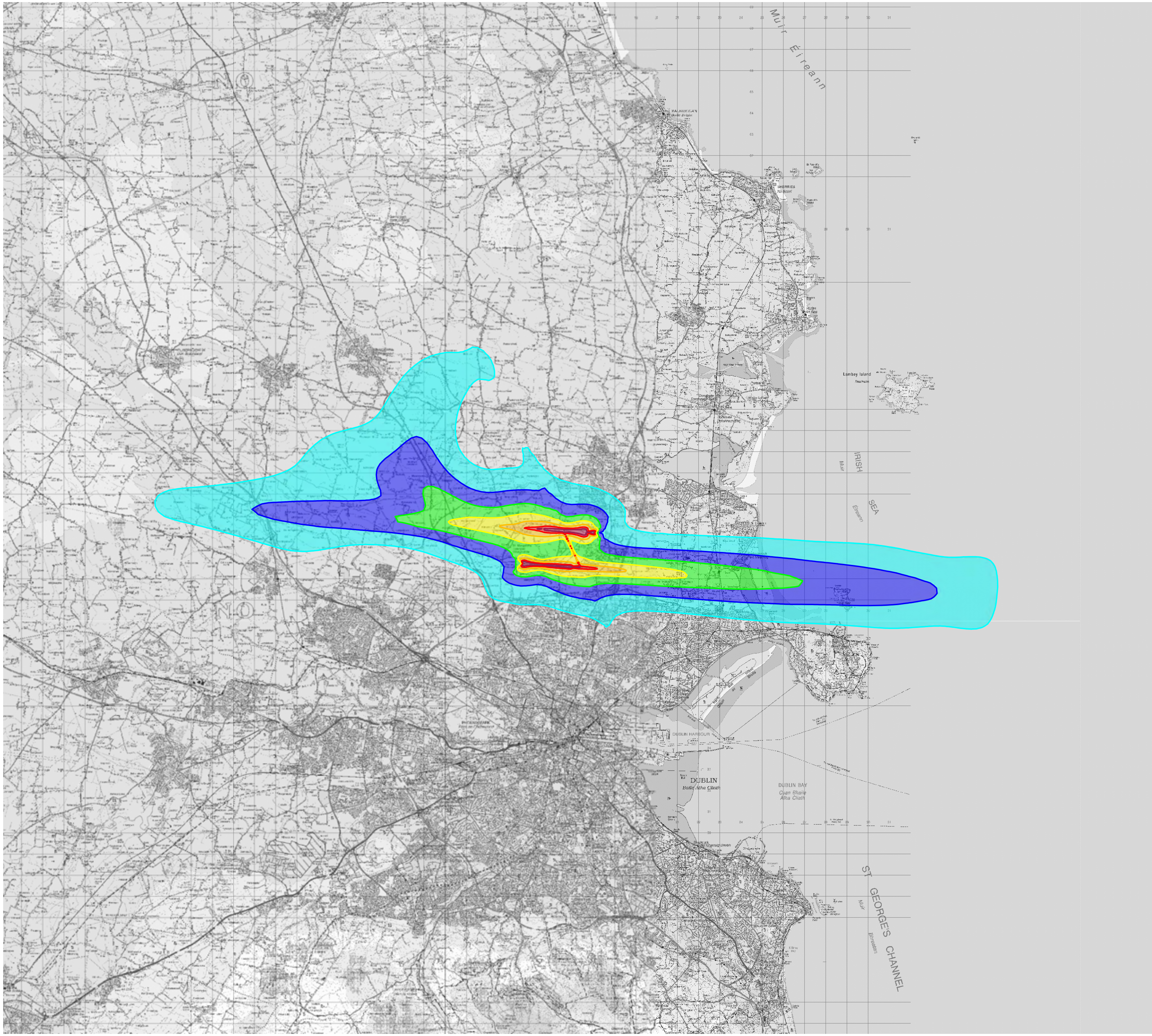

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LEGEND:

- 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) $L_{evening}$

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Forecast Levening Noise Contours
2035 Proposed Scenario
Figure 13C-56

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DATE: July 2021 SCALE: 1:250000@A4

Drawing No:

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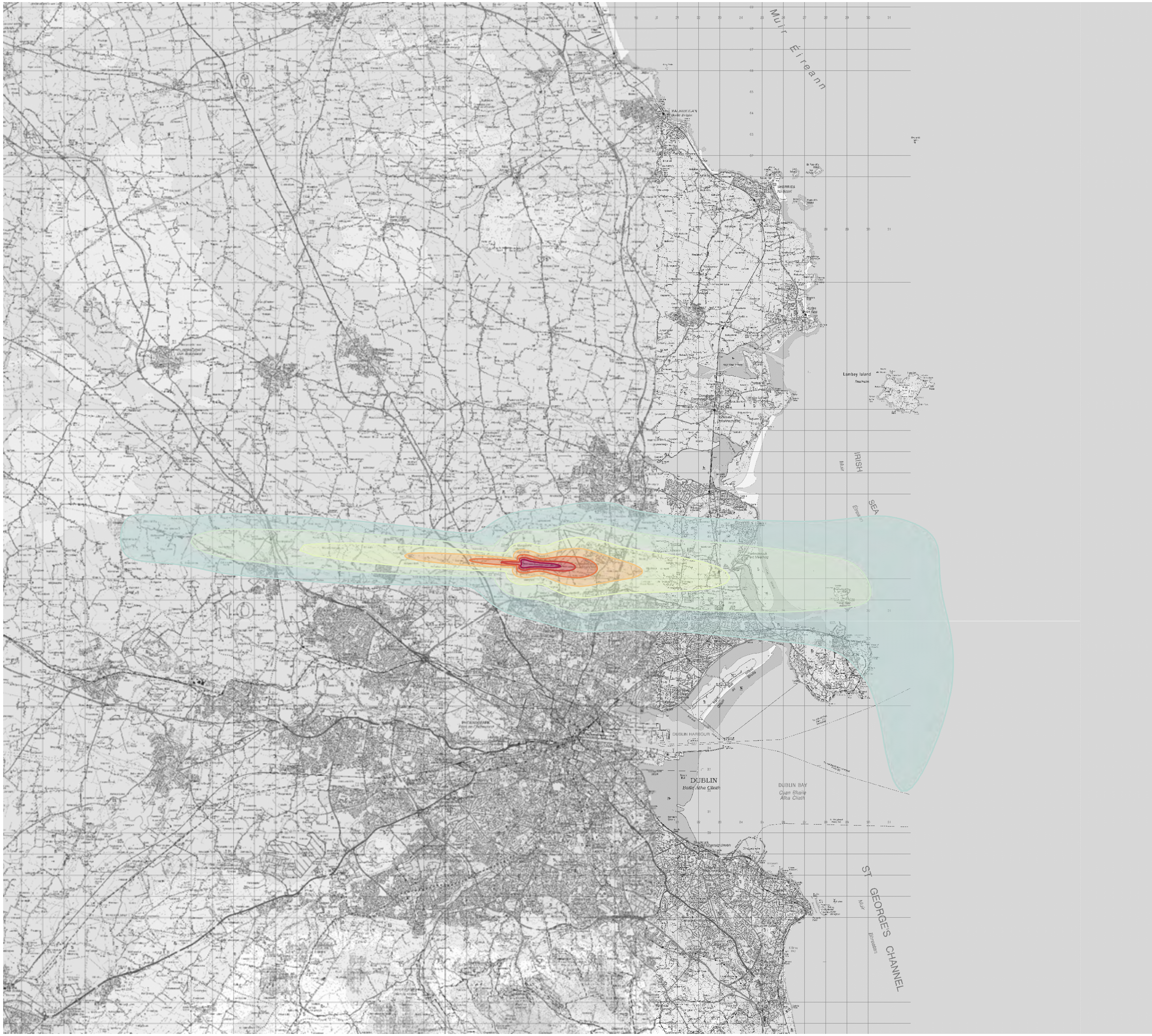

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LEGEND:

- 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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Forecast Lnight Noise Contours (Easterly)
2022 Permitted Scenario
Figure 13C-57

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Drawing No:

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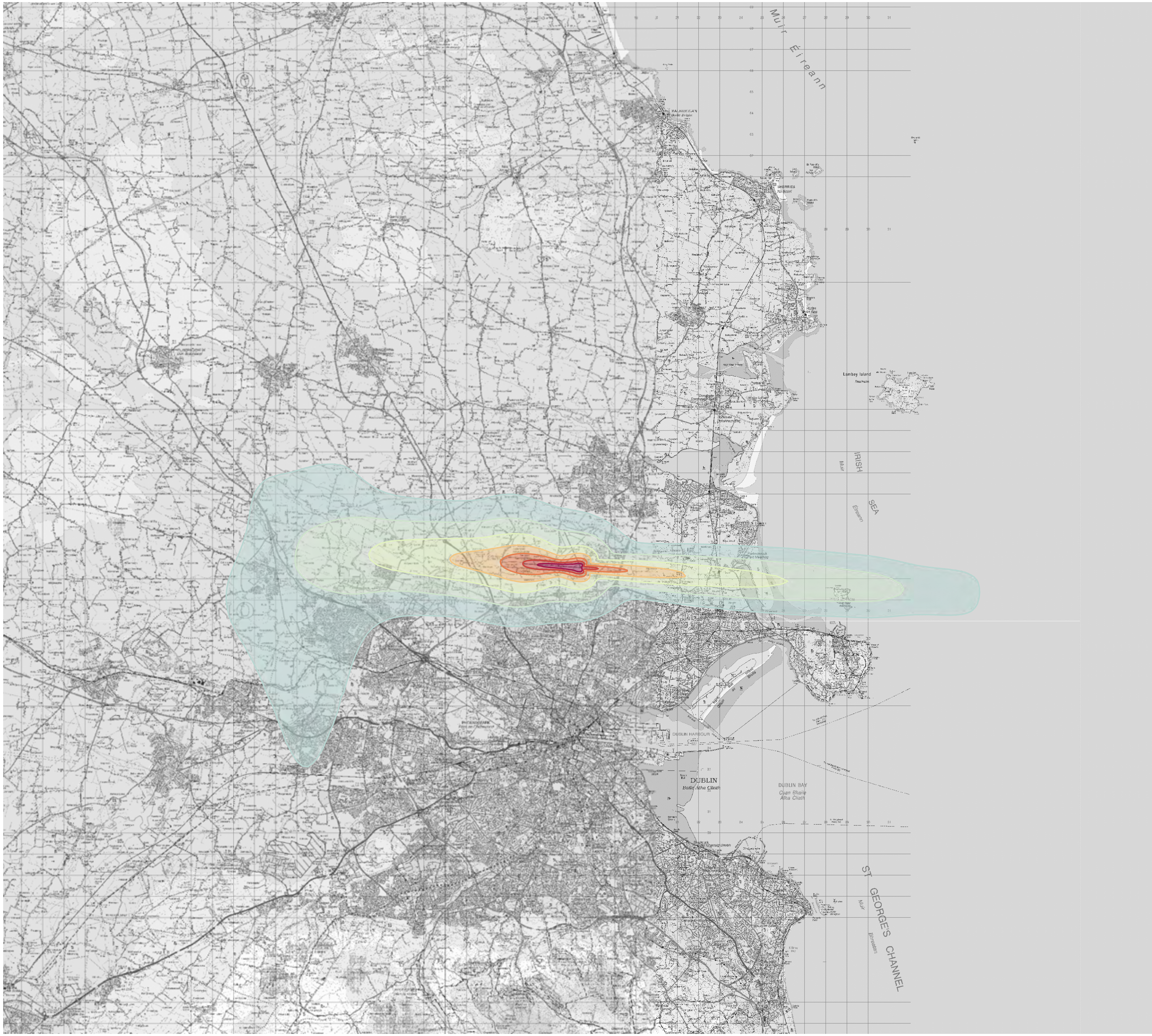

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LEGEND:

- 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 13C-58

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Drawing No:

A11267_19_DR788_2.0

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LEGEND:

- 10 - 24 N60
- 25 - 49 N60
- 50+ N60

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Forecast N60 Noise Contours (Easterly)
2022 Permitted Scenario
Figure 13C-59

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A11267_19_DR789_3.0

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LEGEND:

- 10 - 24 N60
- 25 - 49 N60
- 50+ N60

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Figure 13C-60

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Drawing No:

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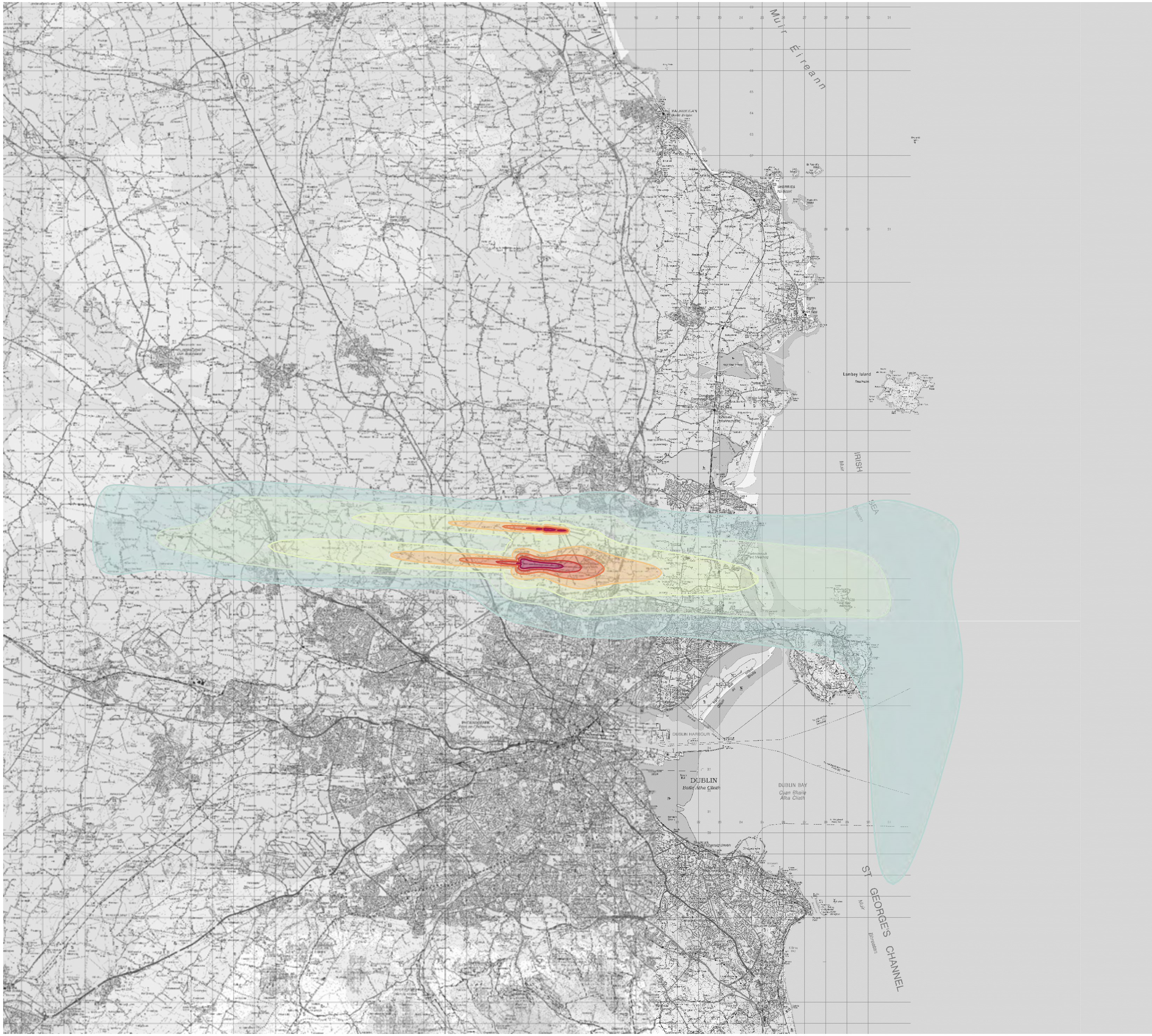

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LEGEND:

- 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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Forecast Lnight Noise Contours (Easterly)
2022 Proposed Scenario
Figure 13C-61

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DATE: July 2021
SCALE: 1:250000@A4

Drawing No:

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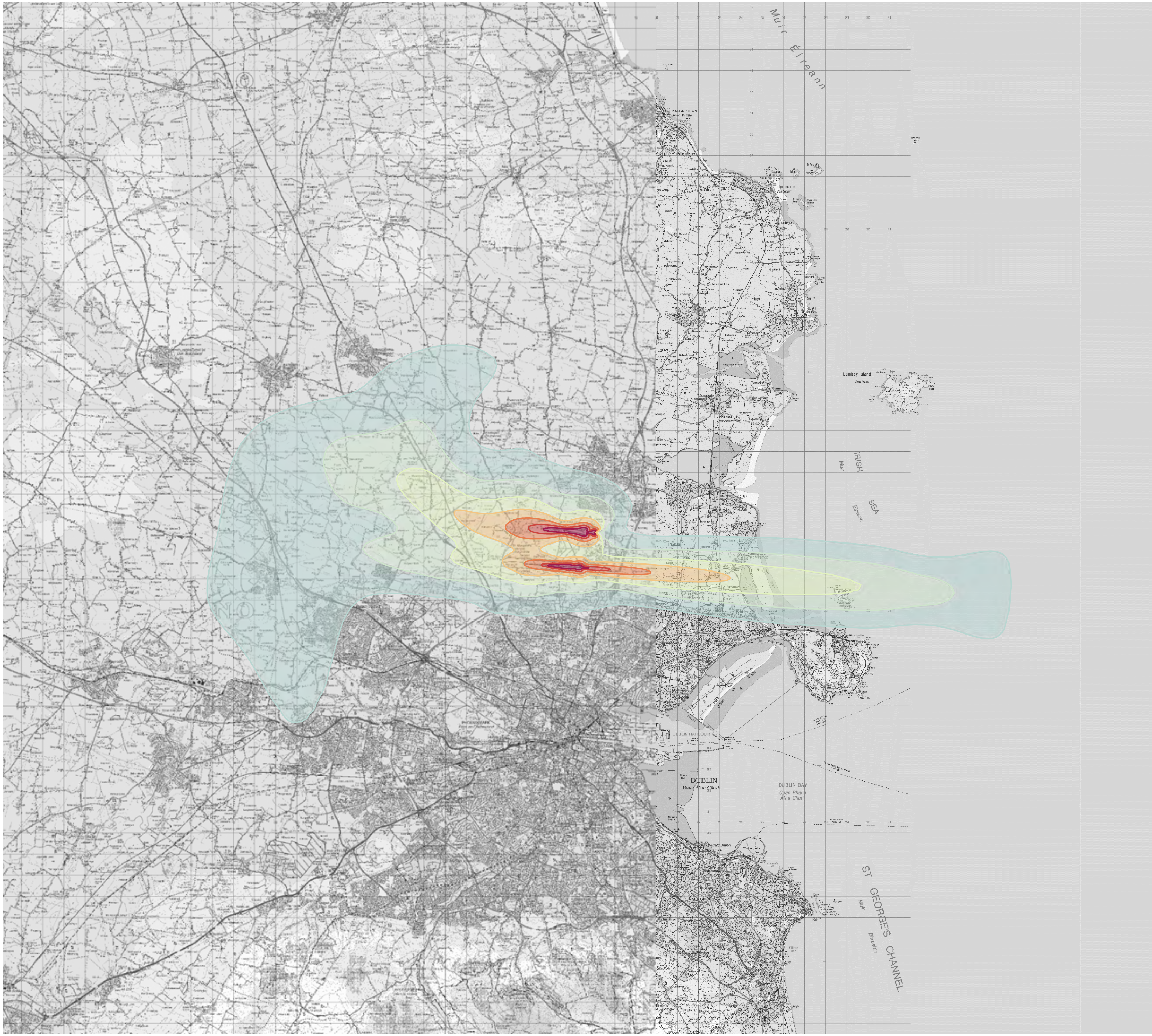

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LEGEND:

- 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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Forecast Lnight Noise Contours (Westerly)
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Figure 13C-62

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DATE: July 2021
SCALE: 1:250000@A4

Drawing No:

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LEGEND:

- 10 - 24 N60
- 25 - 49 N60
- 50+ N60

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Figure 13C-63

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Drawing No:
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LEGEND:

- 10 - 24 N60
- 25 - 49 N60
- 50+ N60

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Figure 13C-64

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