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Dublin Airport

Dublin Airport North Runway, Regulation 598/2014 (Aircraft Noise Regulation) Forecast Without New Measures and Additional Measures Assessment Report

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EXECUTIVE SUMMARY

This report describes the application of Regulation European Union (EU) 598/2014 (the Aircraft Noise Regulation) Annex I Sections 2 and 3 to the evaluation of the need for additional new aircraft noise reduction measures resulting from a relevant action to replace, amend, and/or revoke two night-time operating restrictions described in the *North Runway Planning Permission* document.[1] The two operating restrictions are:

- North Runway Permission, Condition 3(d): Runway 10L-28R (the North Runway) shall not be used for take-off or landing between 2300 and 0700.
- North Runway Permission, Condition 5: The average number of night-time aircraft movements at Dublin Airport shall not exceed 65 per night (between 2300 and 0700) when measured over the 92-day modelling period.

Both operating restriction conditions are forecast to constrain movements and passengers in 2025 when passenger levels return to 32 million passengers per annum (mppa). The assessed impact caused by the two operating restrictions is a loss of air traffic movements in the night period and the associated loss of 1.1 million passengers per year (3.5 percent decrease). This would result in a cumulative loss over the four-year period between 2022, when the North Runway is expected to be operational, and 2025 of 4.3 million passengers. Because of the operating restrictions and constraints, the Irish economy could forgo an additional 3,430 jobs and €963 million in Gross Value Added (GVA) by 2025 (expressed in 2020 prices), relative to unrestricted night movements.[2]

As required by the Aircraft Noise Regulation, the assessment applies the International Civil Aviation Organization's (ICAO) Balanced Approach to Aircraft Noise Management (the Balanced Approach)[3]. The Balanced Approach evaluates the noise situation and potential noise reduction measures against a noise problem and Noise Abatement Objective (NAO), which are both to be set in due course by the Aircraft Noise Competent Authority (ANCA), established by Fingal County Council (FCC). In order to provide the necessary supporting documentation to allow ANCA to carry out their assessment, daa have developed a candidate NAO (cNAO) to provide a basis for assessment of the proposed aircraft noise reduction measures assessed in this Aircraft Noise Regulation analysis. The summary objective of the cNAO states:

> *To limit and reduce the adverse effects of long-term exposure to aircraft noise, including health and quality of life, so that long-term noise exposure, particularly at night, does not exceed the situation in 2018. This should be achieved through the application of the Balanced Approach.*

In addition to the summary objective the cNAO includes additional metrics that may be considered for prioritising measures. This document describes and evaluates the Forecast without New Measures scenario (Aircraft Noise Regulation, Annex I Section 2) and Additional Measures (Aircraft Noise Regulation, Annex I Section 3).

[1] Fingal County Council Ref: F04A/1755/E1, An Bord Pleanála Reference Number PL06F.217429.

[2] InterVISTAS, *Update Report Draft Dublin Airport Economic Impact of Operating Restrictions*, October 2020.

[3] International Civil Aviation Organization, *Guidance on the Balanced Approach to Aircraft Noise Management*, October 10, 2010.

Forecast without New Measures Scenario

Revoking North Runway Permission, Condition 5 and replacing North Runway Permission, Condition 3(d) with a fully mixed-mode runway use configuration[4], while retaining the multiple existing and planned noise management measures listed in **Table 2-1**, would prevent the forgone economic impact and meet the cNAO. This is called the Forecast without New Measures scenario. This scenario meets the cNAO related to reducing the number of people highly annoyed and highly sleep disturbed but would cause an increase in noise levels that has the potential to cause significant adverse effects. The increase would be caused by the increase in air traffic movements between 2018 and 2025 and preferred use of the runways, including the North Runway.

Additional Measures

Due to the potential significant adverse effects resulting from an increase in noise levels under the Forecast without New Measures scenario compared to the 2018 situation, additional new measures to minimise potential significant adverse effects were evaluated in accordance with the Balanced Approach requirements. The evaluation was carried out in the following steps:

- **Step 1**: **Conduct screening assessment of potential mitigation measures.** Twenty-seven types of measures were identified and screened. Twenty-four identified types were eliminated from further consideration because they are either an existing or planned measure included in the Forecast without New Measures or they were determined not to be operationally feasible. Three feasible measure types advanced to Step 2, which are: preferential runway use; runway use respite/alternate runway use; and sound insulation.
- **Step 2**: **Determine effectiveness of feasible measures identified in screening assessment.** Eight preferential runway use measures were evaluated relative to the cNAO and the significant adverse effect levels of the Forecast without New Measures. A single scenario, which minimised the significantly adversely effected population, was selected as the most effective. A proposed sound insulation grant scheme was evaluated to assess the effectiveness of reducing the number of people exposed to the effect if high levels of night-time noise in the selected preferential runway use scenario. The sound insulation grant scheme was shown to be effective in reducing the number of people from high to medium level of impact and was selected as an additional measure.
- **Step 3**: **Determine if operating restriction measures are needed to meet the cNAO and if so, conduct feasibility, effectiveness and cost-effectiveness analysis on operating restriction measures.** The preferential runway use scenario together with the proposed residential sound insulation meet the cNAO and related priority metrics for significant adverse effect and high levels of night-time noise exposure. daa also proposes to include a limitation on the use of Runway 10L-28R between 0000 and 0559 and a Quota Count (QC) measure to ensure that noise levels forecast to occur in 2025 meet the cNAO.
- **Step 4**: **Determine cost-effectiveness of feasible measures considered effective.** A cost-effectiveness analysis was conducted for the selected new additional measures. The analysis is described in detail in the *Dublin Airport North Runway, Regulation 598/2014 (Aircraft Noise Regulation) Cost Effectiveness Analysis* report by Ricondo & Associates, Inc.

The process also evaluated possible environmental and competitive effects of the selected measures and determined there would be no related effects on other airports, operators, or other interested parties. The

[4] The fully mixed mode runway use configuration keeps both runways available for use without considering the location of sensitive areas. This runway use configuration would facilitate the theoretical maximum capacity of the runway system.

resulting recommended Preferred Option includes the following new measures in addition to the existing and planned noise reduction measures:

- Three-Runway Preferential Runway Use
  - 0700 to 2259: 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. 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
  - 2300 to 2359: Same as preferential runway use between 0700 to 2259.
  - 0000 to 0559 – Limit take-off or landings to South Runway (Runway 10L-28R) 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 or where Runway 10R-28L length is required for a specific aircraft type. Refer to the proposed runway use limitation measure below for further restrictions on the use of the North Runway between 0000 and 0559.
  - 0600 to 0659 - Same as preferential runway use between 0700 to 2259.
- Proposed Residential Sound Insulation Grant Programme: Provide sound insulation grant assistance to sound insulate dwelling units with exterior levels at 55 dB L_{night} or higher based on forecast 2025 levels.
- Proposed runway use limitation: Runway 10L-28R shall not be used for take-off or landing between 0000 hours and 0559 hours (except in cases of safety, maintenance considerations, exceptional air traffic conditions, adverse weather, technical faults in air traffic control systems or declared emergencies at other airports or where Runway 10R-28L length is required for a specific aircraft type)
- Proposed Annual Night Quota (ANQ) count of 7,990 between 2330 to 0600 (Night Quota Period [NQP]) to be applied for each year from the opening of the North Runway to 2025.

This Preferred Option is considered the Forecast including Additional Measures scenario.[5] Because the Forecast including Additional Measures scenario and the Permitted Operations Situation scenario (the Permitted Operations Situation is the scenario with Condition 3(d) and Condition 5 as currently framed in place in 2025) both meet the cNAO, a cost-effectiveness analysis was conducted to compare the Forecast including Additional Measure scenario to the Permitted Operations Situation scenario to assess which of the two is more cost-effective.

For purposes of the North Runway application, the Forecast including Additional Measures proposes the following Relevant Action:

- Amend Condition 3(d) so that it reads: *Runway 10L-28R shall not be used for take-off or landing between 0000 and 0559 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 or where Runway 10L-28R length is required for a specific aircraft type.*
- Replace the existing operating restriction imposed by Condition 5 with a noise quota system also known as an Annual Night Quota (ANQ) that would read: *A noise quota system for night-time noise will be introduced*

[5] According to the *Aircraft Noise Information Reporting under The Airport Noise (Dublin Airport) Regulation Act 2019 Draft Version 2.0* guideline document provided on May 2020, the Airport Noise Competent Authority defines "Forecast including Additional Measures" as a scenario that represents the noise conditions that would arise from any development proposals inclusive of specific or combinations of noise mitigation measures.

at the airport. The airport shall be subject to an annual noise quota of 7,990 between the hours of 2330 and 0600.

The Forecast including Additional Measures, which includes the Relevant Actions, is referred to as the Proposed Relevant Action in the Environmental Impact Report Assessment (EIAR).

Table ES-1 presents the cost-effectiveness results for the Forecast including Additional Measures and the Permitted Operations Situation scenarios based on the cost to implement divided by the change in population noise exposure levels compared to the 2018 situation.

TABLE ES-1 COST-EFFECTIVENESS OF FORECAST INCLUDING ADDITIONAL MEASURES VERSUS PERMITTED OPERATIONS SITUATION COMPARED TO 2018

	COST-EFFECTIVENESS RATIO TO REDUCE NUMBER OF PEOPLE HIGHLY SLEEP DISTURBED (HSD)		COST-EFFECTIVENESS RATIO TO REDUCE NUMBER OF PEOPLE HIGHLY ANNOYED (HA)	
SCENARIO	2025	CER RANKING	2025	CER RANKING
Forecast including Additional Measures	€113	1	€49	1
Permitted Operations Situation	€42,215	2	€21,162	2

NOTES:
CER Ranking based on lowest to highest absolute value ratio.
CER – Cost-Effectiveness Ratio
SOURCE: Ricondo & Associates, Inc., October 2020.

According to the Aircraft Noise Regulation, operating restrictions should only be considered if needed to meet an objective and if not more restrictive than necessary to meet an objective. The Permitted Operations Situation by itself would meet the cNAO but is more restrictive and not as cost-effective compared to the Forecast including Additional Measures scenario.

1. INTRODUCTION

This report describes the application of the Regulation European Union (EU) 598/2014 (the Aircraft Noise Regulation) Annex I Sections 2 and 3 to the evaluation of the need for additional new noise reduction measures resulting from a relevant action to replace, amend, and/or revoke two night-time operating restrictions described in the *North Runway Planning Permission* document.[6] The two operating restrictions are:

- North Runway Permission, Condition 3(d): Runway 10L-28R (the North Runway) shall not be used for take-off or landing between 2300 and 0700.
- North Runway Permission, Condition 5: The average number of night-time aircraft movements at Dublin Airport shall not exceed 65 per night (between 2300 and 0700) when measured over the 92-day modelling period.

Both operating restriction conditions are forecast to constrain movements and passengers in 2025 when passenger levels return to 32 million passengers per annum (mppa). The assessed impact caused by the two operating restrictions is a loss of air traffic movements in the night period and the associated loss of 1.1 million passengers per year (3.5 percent decrease). This would result in a cumulative loss over the four-year period

[6] Fingal County Council Ref: F04A/1755/E1, An Bord Pleanála Reference Number PL06F.217429.

between 2022, when the North Runway is expected to be operational, and 2025 of 4.3 million passengers. Because of the operating restrictions and constraints, the Irish economy could forgo an additional 3,430 jobs and €963 million in Gross Value Added (GVA) by 2025 (expressed in 2020 prices), relative to unrestricted night movements.

As required by the Aircraft Noise Regulation, the assessment applies the International Civil Aviation Organization's (ICAO) Balanced Approach to Aircraft Noise Management (the Balanced Approach)[7]. The Balanced Approach evaluates the noise situation and potential noise reduction measures against a Noise Abatement Objective (NAO), which is to be set in due course by the Aircraft Noise Competent Authority (ANCA), established by Fingal County Council (FCC). In order to provide the necessary supporting documentation to allow ANCA to carry out their assessment, daa have developed a candidate NAO (cNAO) to provide a basis for assessment of the proposed aircraft noise reduction measures assessed in this Aircraft Noise Regulation analysis. The summary objective of the cNAO states:

> *To limit and reduce the adverse effects of long-term exposure to aircraft noise, including health and quality of life, so that long-term noise exposure, particularly at night, does not exceed the situation in 2018. This should be achieved through the application of the Balanced Approach.*

In addition to the summary objective the cNAO includes additional metrics that may be considered for prioritising measures.

In general, the cNAO seeks to limit aircraft noise from Dublin Airport so that the impact on people is no worse than the 2018 situation. This should be considered the limit from which daa should reduce its noise impacts. The Balanced Approach should be used to ensure that all practicable and sustainable measures are implemented to reduce noise impact from aircraft movements at Dublin Airport. Refer to the *Dublin Airport North Runway, Noise Information for the Regulation 598/2014 (Aircraft Noise Regulation) Assessment* report by Bickerdike Allen Partners LLP for more information on the methodology to measure the cNAO.

The information contained in this report is based on multiple technical analyses conducted to support the Aircraft Noise Regulation assessment for Dublin Airport. Section 2 describes the Forecast without New Measures scenario; the future condition without operating restrictions or mitigation measures that currently do not exist or are unplanned.[8] Section 3 describes the screening assessment for potential new mitigation measures, a summary of the Preferred Option that becomes the Forecast including Additional Measures scenario, and the results of the cost-effectiveness analysis. Section 4 compares the Forecast including Additional Measures scenario to the situation with the North Runway Planning Permission's operating restrictions at night, called the Permitted Operations Situation scenario.[9]

[7] International Civil Aviation Organization, *Guidance on the Balanced Approach to Aircraft Noise Management*, October 10, 2010.

[8] Mitigation measures as defined in the Aircraft Noise (Dublin Airport) Regulation Act 2019 are noise mitigation measures in place at the airport but does not include in an operating restriction.

[9] Night or night-time hours are between 2300 and 0700.

2. FORECAST WITHOUT NEW MEASURES

2.1 DESCRIPTION

A noise issue may be identified using a forecast scenario that includes a relevant action (as defined in the Aircraft Noise [Dublin Airport] Regulation Act 2019) that is proposed without implementing new noise mitigation measures and/or operating restrictions. Annex I of the Aircraft Noise Regulation calls this scenario the Forecast without New Measures. As stated in Annex I, a study of the noise impact on the surrounding area caused by expanding the capacity, runways, and terminals and by modifying flight paths and approach and take-off routes without implementing further new mitigation measures is required. The Aircraft Noise (Dublin Airport) Regulation Act 2019 also identifies relevant actions that introduce new mitigation measures and/or seek to revoke, amend or replace an existing operating restriction or existing noise mitigation measures.[10] As a result of the Aircraft Noise (Dublin Airport) Regulation Act 2019, the Forecast without New Measures scenario can also represent a situation which would prevail as a result of revoking, amending or replacing an operating restriction without adding any new noise reduction measures. This scenario should be representative of an unconstrained/unrestrictive operation.

The Forecast without New Measures scenario for the North Runway Aircraft Noise Regulation analysis includes revoking two existing noise related operating restrictions for the North Runway. As previously stated, this scenario represents a development proposal without any noise-related actions. For example, a preferential runway use measure would be replaced by a runway use configuration that keeps all runways available for use irrespective of noise-sensitive locations. This scenario includes the 32 mppa combined Terminal 1 and Terminal 2 passenger capacity limit described in Condition 3 of the Terminal 2 Planning Permission (An Bord Pleanála Ref: PL 06F.217429; FCC Reg. Ref. F06A/1248) and Condition 2 of the Terminal 1 Extension Planning Permission (Fingal County Council Reg. Ref. No. F06A/1843; ABP Ref. No. PL06F.223469), and is accounted for in the forecast analysis.[11] Details related to the definition of the Forecast without New Measures scenario are provided in Section 2.1.1. The Forecast without New Measures scenario includes existing and planned measures described in Section 2.1.2 to manage aircraft noise. Sections 2.1.3, 2.1.4, and 2.1.5 summarise the forecast traffic and fleet mix movements, runway use and approach / take-off flight tracks assumed for the Forecast without New Measures scenario, respectively.

2.1.1 FORECAST WITHOUT NEW MEASURES DESCRIPTION

Permission granted to Dublin Airport for the development of Runway 10L-28R (North Runway) restricts the use of North Runway at night and places a cap on the number of movements between 2300 and 0700. This scenario is called the Permitted Operations Situation scenario.

In addition to the operating restrictions imposed by the *North Runway Planning Permission* document, Condition 3 of the planning permission granted for Terminal 2 (An Bord Pleanála Ref. PL 06F.220670 and Fingal County Council Reg. Ref. F06A/1248) (the "Terminal 2 Permission") and Condition 2 of the Terminal 1 extension planning permission [FCC Reg. Ref. F06A/1843; ABP Ref: PL06F.223469]) (the "Terminal 1 Expansion Permission") includes a passenger capacity limit. Condition 3 for the Terminal 2 Permission states the following:

[10] Aircraft Noise (Dublin Airport) Regulation Act 2019, Section 34.C (23).

[11] Mott MacDonald, *Dublin Airport Operating Restrictions - Quantification of Impacts on Future Growth September 2020 Update 2022 2025 Period*, version 5.3, September 2020.

> *The combined capacity of Terminal 2 as permitted together with Terminal 1 shall not exceed 32 million passengers per annum unless otherwise authorised by a further grant of planning permission.*

Condition 2 for the Terminal 1 Expansion Permission states:

> *The combined capacity of Terminal 1 (including the extension authorised by this grant of permission) and Terminal 2 granted permission under planning register reference number F06A/1248 (An Board Pleanála appeal reference number PL 06F.220670) shall not exceed 32 million passengers per annum unless otherwise authorised by a further grant of planning permission.*

The Forecast without New Measures scenario does not seek any amendment of the Terminal 1 and 2 passenger capacity conditions or the conditions in the *North Runway Planning Permission* document governing the general operation of the runway system (i.e., conditions that are not specific to night-time use, namely Conditions 3(a), 3(b), 3(c) and 4 of the *North Runway Planning Permission* document).

The Forecast without New Measures scenario revokes two operating restrictions while meeting the cNAO. This scenario does not require the development of any physical or other infrastructure on the North Runway site or the wider Dublin Airport site.

The two operating restrictions are the following conditions described in the *North Runway Planning Permission*:[12]

- North Runway Permission, Condition 3(d): Runway 10L-28R shall not be used for take-off or landing between 2300 and 0700.
- North Runway Permission, Condition 5: The average number of night-time[13] aircraft movements at Dublin Airport shall not exceed 65 per night (between 2300 and 0700) when measured over the 92-day modelling period.[14]

The Forecast without New Measure scenario revokes Condition 3(d) and introduces a fully mixed mode runway use configuration that has both runways available for use at night without any consideration for the location of sensitive areas. North Runway Permission, Condition 3(d) is revoked and the fully mixed mode runway use configuration that does not have a noise preference and would facilitate the theoretical maximum capacity of the runway system would be implemented. The Forecast without New Measures scenario also revokes North Runway Permission, Condition 5 and removes limits to the number of movements at night.

The Forecast without New Measure scenario represents the three-runway airfield with the revocation of the two operating restrictions previously described without any new noise mitigation measures.[15] This scenario represents a condition where there are no movement operating restrictions and/or limits (required or voluntary) to how and where movements occur on the North and South Runways. This condition also includes existing and planned noise mitigation measures.

[12] An Bord Pleanála Reference Number PL06F.217429/Fingal County Council Ref: F04A/1755/E1

[13] Night-time represents the hours between 2300 and 0700.

[14] An Bord Pleanála Reference Number PL06F.217429/Fingal County Council Ref: F04A/1755/E1.

[15] Noise mitigation measure is defined by the Aircraft Noise (Dublin Airport) Regulation Act 2019 as a measure in place at the airport but does not include an operating restriction. Mitigation measures include includes land use planning and management measures, measures to reduce noise at source and noise abatement operational measures (other than operating restrictions) that do not restrict the capacity of the airport.

The Forecast without New Measures scenario does not represent the Preferred Option, and the action to revoke the two operating restrictions can change as a result of additional new measures analysis. The focus of this Aircraft Noise Regulation assessment is to determine the need to introduce new noise mitigation measures to meet the cNAO and minimise significant adverse effects caused by removing operating restrictions compared to baseline conditions set in the cNAO (note, for the purposes of this assessment, 2018 has been established as the baseline year).

If the Forecast without New Measures scenario meets the cNAO with the least level of significant adverse effects caused by increases in noise, no additional new measures are needed. If it does not meet the cNAO, additional new measures will be needed. Additional new measures could lead to modifying the action of revoking the two operating restrictions to replacing, amending, and/or revoking with the addition of new mitigation measures. If the new mitigation measures do not meet the cNAO, a least-restrictive operating restriction may be necessary. This could lead to amending or replacing one or both restrictions with the addition of new operating restriction measures. The recommended relevant action will depend on the results of the Balanced Approach assessment and the cost-effectiveness analysis. The group of measures considered to be the most cost-effective would be considered the Preferred Option. This assessment is described in Section 3.

2.1.2 EXISTING AND PLANNED MEASURES

The Noise Action Plan[16] and conditions associated with the *North Runway Planning Permission* document issued by An Bord Pleanála in 2007[17] encompasses an extensive aircraft noise management programme that includes 24 existing and planned measures covering the four principal elements of the Balanced Approach.[18] **Table 2-1** lists the existing and planned measures by the principal elements, with a description of the impact and contribution each has on the noise situation. The measures listed include those that exist (2018) and those planned when the North Runway is operational in future years. The existing and planned measures expected to be in place in 2025 are assumed for the Forecast without New Measures scenario. Of the 24 existing or planned measures listed, two land use planning and management measure (LU-4 and LU-5 in Table 2-1) will be completed prior to opening the North Runway. One of the two measures (LU-5 described in Table 2-1) will continue after the North Runway is operational with eligibility being reviewed every two years. The two operational mitigation measures that are assumed to discontinue after the North Runway is completed in 2022 are the preferential runway use and the noise preferential routes (NPR) for the two-runway layout (NA-1 and NA-2 described in Table 2-1). The NA-2 measure would be replaced by measure NA-10. Replacement of measure NA-1 will depend on the findings of this Aircraft Noise Regulation assessment. Nineteen measures will remain in place in 2025.

The two operational measures that are assumed to discontinue are the preferential runway use and NPR, because the two are based on a two-runway layout. The Forecast without New Measures scenario involves a three-runway airfield and assumes the same arrival and departure flight procedure concepts proposed by daa for the North Runway as a result of the second consultation, which sought input from interested stakeholders and local communities on the selection of future flight paths for the North Runway.[19] The NPRs selected, following the consultation process, route departing aircraft straight out on the South Runway. North Runway departures to the west diverge to the north by either 15-degrees or 75-degrees. North Runway departures to the east diverge to the north by 15-degrees. Main airport and community stakeholders were consulted on these NPRs throughout 2016 and 2017 prior to the design of airspace and safety assessment by the Irish Aviation Authority (IAA) in 2018 and 2019. IAA Safety Regulation Division conducted a safety case analysis and concluded

[16] Fingal County Council. *Noise Action Plan for Dublin Airport 2019 and 2023*, December 2018.

[17] An Bord Pleanála Reference Number PL06F.217429/Fingal County Council Ref: F04A/1755/E1.

[18] International Civil Aviation Organization, *Guidance on the Balanced Approach to Aircraft Noise Management*, October 10, 2010.

[19] daa, *North Runway Report Consultation on Flight Paths and Change to Permitted Operations*, February 2017.

the divergent headings from Runway 28R required to be 30-degrees or 75-degrees in order to allow for safe missed approach and go-around procedures when the runways are operational. The preferred NPR were considered an existing measure, identified as NA-9 in Table 3-1, for purposes of this Aircraft Noise Regulation assessment. As noted in the description of the Forecast without New Measures scenario above, the existing and planned measures include the operating restriction on Runway 16-34 required under Condition 4 described in the *North Runway Planning Permission* document.[20] In addition, the residential sound insulation schemes, based on the 2016 and 2022 63 dB $L_{Aeq,16hr}$ noise contours, are expected to be completed by the time the North Runway is operational.

For purposes of this Aircraft Noise Regulation assessment, residential sound insulation is considered feasible as a land use planning and management measure to reduce exposure to the effects of exterior noise levels within a dwelling unit although it does not reduce external noise exposure. Based on the Environmental Protection Agency (EPA) draft guidelines, sound insulation is considered mitigation by reduction intended to deal with effects that cannot be avoided by focusing on reduction of exposure on the receptor.[21] For the purposes of this analysis, sound insulation does not remove the dwelling unit from the noise exposure area but reduces the level of impact on people inside a dwelling by 5 dB during night-time hours. Any dwellings eligible for the existing scheme or exposed to at least 63 dB $L_{Aeq,16hr}$ in a future scenario have been considered here as having a reduction of 5 dB for both their L_{den} and the L_{night} exposure based on noise measurements undertaken for the existing insulation schemes. Dwellings not eligible for the existing and planned schemes, but eligible for the new scheme proposed as an additional measure, have been considered here as having a reduction of 5 dB L_{night} exposure, and a reduction of 5 dB for the night component of their L_{den} exposure. While this type of analysis is useful in assessing how the internal conditions within dwellings might benefit from insulation and reduce impact levels inside the dwelling, it does not account for external amenity areas of dwellings. Use of external amenity areas however relate primarily to daytime and evening noise levels, which are largely unaffected by the Forecast without New Measures scenario. Allowing for the benefit of the residential sound insulation schemes in general reduces the number of people assessed with high levels of impact. This reduction is accounted for in calculating number of people highly annoyed, highly sleep disturbed and exposed to night-time levels at or higher than 50 dB L_{night} and at or higher than 55 dB L_{night}.

[20] Fingal County Council Ref: F04A/1755/E1, An Bord Pleanala Reference Number PL06F.217429

[21] Environmental Protection Agency, *Guidelines on the information to be Contained in Environmental Impact Assessment Reports - DRAFT*, August 2017.

TABLE 2-1 (1 OF 3) EXISTING AND PLANNED NOISE MANAGEMENT MEASURES

MEASURE ID	SOURCE	MEASURE DESCRIPTION	2018	2025
Reduction of Noise at Source (NS)				
NS-1	FCC NAP	Promote quieter aircraft through incentives such as FlyQuiet programmes. This programme is expected to be in place by 2022.	✗	✓
NS-2	FCC NAP	Work with airline partners to introduce quieter aircraft, particularly at night, including consideration of incentives. Approaches to incentives under development and expected to be in place by 2022.	✗	✓
Noise Abatement (NA) Operating Procedures				
NA-1	FCC NAP; daa NMP; Dublin Airport Aeronautical Information Publication	*Two-Runway Preferential Runway Programme* – Intent of measure is to utilise whenever possible the runways that enable aircraft to avoid noise-sensitive areas during the initial departure and final approach phases of flight. Runway 10 or Runway 28 is the required runway between 0600 and 2300HR local time when the crosswind component is 20KT or less. Runway 28 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 10 or Runway 28 is greater than 20KT, Runway 16 or Runway 34 may become the active runway. If the forecast crosswind component on Runway 10 or 28 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. Runways will be prioritised for noise abatement purposes between 2300 and 0600HR local time, subject to the same wind calculation method and values as used between 0600 and 2300HR local time (see Section 5). When weather conditions and flight movements permit, runway usage will be prioritised as follows: Arrivals: #1 (Runway 10), #2 (Runway 16), #3 (Runway 28), #4 (Runway 34); Departures: #1 (Runway 28), #2 (Runway 34), #3 (Runway 10), #4 (Runway 16).	✓	✗
NA-2	FCC NAP; daa NMP; Dublin Airport Aeronautical Information Publication	*Two-Runway Noise Preferential Routes (NPRs) and Track Keeping* – Intent is to minimise disruption by routing aircraft away from built-up areas, where possible. Unless directed otherwise by IAA-ATC, all aircraft taking off from Dublin Airport are required to follow specific NPRs. To minimise impact, NPRs are designed to avoid overflight of built-up areas, where possible. An NPR is a path or corridor (1.8 kilometres at its widest point) that aircraft follow from take-off until being directed by IAA-ATC onto their main air traffic routes, typically at 3,000 feet altitude above mean sea level. Aircraft flying inside the NPR corridor are flying on-track. Departures from all runways (except easterly departures on the existing Runway 10/28) must maintain course straight out for 5 nautical miles (1 nautical mile = 1,852 metres) after take-off before commencing a turn, unless otherwise cleared by IAA-ATC. Easterly departures on the existing southern runway must maintain course straight out for 5 nautical miles before commencing a turn to the north, or to 6 nautical miles before commencing turn to the south. Once an aircraft reaches the end of the NPR, or at an altitude of 3,000 feet, IAA-ATC will turn it onto a more direct heading to its destination. IAA-ATC can turn aircraft off NPRs below 3,000 feet for safety reasons, for example to avoid storms.	✓	✗
NA-3	FCC NAP; daa NMP; Dublin Airport Aeronautical Information Publication	*Noise Abatement Departure Procedures (NADP) Climb Profile* – Based on noise-abatement departure climb guidance contained in the ICAO's Procedures for Air Navigation Services Aircraft Operations Document 8168 Volume 1, Flight Procedures Appendix to Chapter 3 – NADP2, with thrust cutback at 1,500 feet.	✓	✓
NA-4	Dublin Airport Aeronautical Information Publication	*Visual Approach* – Jet aircraft (Cat C/D) on visual approach to Runways 28, 10, 16, and 34 must join final approach no closer than 6 nautical miles from touchdown. Aircraft must follow a descent path that will not result in being at any time lower than the approach path, which would otherwise be followed using the ILS glide path.	✓	✓
NA-5	FCC NAP	*Continuous Decent Approach (CDA)* – Operates a CDA that reduces the noise experienced on the ground by reducing the overall thrust required during the initial descent and keeping aircraft at higher altitudes for a longer period of time.	✓	✓

TABLE 2-1 (2 OF 3) EXISTING AND PLANNED NOISE MANAGEMENT MEASURES

MEASURE ID	SOURCE	MEASURE DESCRIPTION	2018	2025
NA-6	IAA ATC	*Continuous Climb Operations* - continuous climb operations along a standard departure procedure is intended to limit interruption of the climb profile to cruise altitude and reduces the noise experienced on the ground caused by thrust levels required to keep aircraft level and increases distance from noise-sensitive areas between an aircraft and receptor as soon as possible.	✓	✓
NA-7	FCC NAP; daa NMP; Dublin Airport Aeronautical Information Publication	*Reverse Thrust* – Reverse thrust is used to aid the deceleration of aircraft on landing using the aircraft's engines. This should not be used at night, unless required for safety reasons.	✓	✓
NA-8	FCC NAP; daa NMP	*Engine Ground Running* – Engine test runs are not permitted between 2000HRs and 0700HRs. All aircraft types may undertake testing between 0900 and 2000HRs, and only aircraft up to Code C may undertake engine testing between 0700 and 0900HRs.	✓	✓
NA-9	FCC NAP; daa NMP	*Monitor and Report* – Sustain noise operating procedures through monitoring.	**Partial**	✓
NA-10	Accepted NPR for North Runway	*Three-Runway Noise Preferential Routes (NPRs) or Environmental Corridors (ECs) and Track Keeping* – Intent is to minimise disruption by routing aircraft away from built-up areas, where possible. Unless directed otherwise by IAA-ATC, all aircraft taking off from Dublin Airport are required to follow specific NPRs. To minimise impact, NPRs are designed to avoid overflight of built-up areas, where possible. An NPR is a path or corridor (1.8 kilometres at its widest point) that aircraft follow from take-off until being directed by IAA-ATC onto their main air traffic routes, typically at 3,000 feet altitude above mean sea level. Aircraft flying inside the NPR corridor are flying on-track. The preferred departure flight path NPR is straight out on the South Runway and divergence paths of 30-degrees and 75-degrees for the North Runway for westerly flow and straight out on the South Runway and a divergent path of 15-degreesd for easterly flow.	✗	✓
Land Use (LU) Planning and Management				
LU-1	FCC NAP; daa NMP; FCC County Development Plan; Dublin Airport LAP	*Land Use Compatibility Management Framework* – The land use and planning frameworks include the FCC's County Development Plan 2017–2023 (Variation No. 1) and the Dublin Airport 2020 Local Area Plan (LAP), which defines four airport noise zones and the associated objective of each zone along with an indication of the potential noise exposure from movements at Dublin Airport. The zones are based on potential noise exposure levels ($L_{Aeq,16hr}$ and L_{night} levels) due to Dublin Airport using either the new northern or existing southern runway for arrivals or departures. The noise zoning system has been developed with the overarching objective to balance the potential impact of aircraft noise from Dublin Airport on both external and internal noise amenity. This allows larger development which may be brought forward in the vicinity of Dublin Airport's flight paths to be identified and considered as part of the planning process. The focus of the noise zones is to ensure compatibility of residential development and ensuring compatibility with pertinent standards and guidance in relation to planning and noise	✓	✓
LU-2	FCC NAP	*Land Use Compatibility Management Review* – Keep under review land-use policies in relation to aircraft noise through the review of existing land-use planning frameworks in so far as they relate to Dublin Airport.	✓	✓
LU-3	FCC NAP	*Encroachment Management* – Monitor noise encroachment associated with Dublin Airport to ensure airport noise policy is appropriately informed through land-use planning frameworks in so far as they relate to Dublin Airport.	✓	✓
LU-4	FCC NAP; daa NMP	*Sound Insulation (HSIP)* – Voluntary to households that qualify by being located within the 2016 63 dB $L_{Aeq,16hr}$ noise contour.	✓	✗
LU-5	North Runway Planning Permission Condition 7	*Sound Insulation (RNIS)* – Voluntary to households that qualify by being located within the 2022 63 dB $L_{Aeq,16hr}$ noise contour. All properties to be completed by the time North Runway is operational.	✗	✓

TABLE 2-1 (3 OF 3) EXISTING AND PLANNED NOISE MANAGEMENT MEASURES

MEASURE ID	SOURCE	MEASURE DESCRIPTION	2018	2025
LU-6	North Runway Planning Permission Condition 9	*Voluntary Dwelling Purchase Scheme* – Approved in 2016, this measure provides voluntary acquisition of eligible dwellings. Eligibility for the scheme is based on the predicted 69dB $L_{Aeq,16hr}$ contour. This is the noise threshold for participation in the voluntary scheme. The scheme is completely voluntary and places no obligation on any resident to participate. Offers to purchase will include a 30 percent premium on the current market value of the residence. Property valuations will be based on current movements at Dublin Airport and accordingly valuations will not be affected by the new runway. The scheme will remain available for three years after North Runway is operational (2025).	✓	✓
LU-7	North Runway Planning Permission Condition 6	*Voluntary School Sound Insulation* - voluntary noise insulation of schools for all schools and registered pre-schools predicted to fall within the contour of 60 dB $L_{Aeq,16hr}$. The scheme is designed to ensure that maximum noise limits within the classrooms and school buildings generally shall not exceed 45 dB $L_{Aeq,8hr}$ (a typical school day).	✗	✓
Operating Restrictions (OR)				
OR-1	North Runway Planning Permission Condition 4	Crosswind runway (16-34) shall be restricted to essential occasional use on completion of the new runway in accordance with Objective DA03 of the Fingal County Development Plan, 2005-2011. 'Essential' use shall be interpreted as use when required by international regulations for safety reasons.	✗	✓
Monitoring and Community Engagement (CE)				
CE-1	FCC NAP; daa NMP	*Stakeholder Engagement* – Participate in regular meetings with the Dublin Airport Environment Working Group and Community Liaison Group.	✓	✓
CE-2	FCC NAP; daa NMP	*Community Engagement Programme* – Includes newsletters and various programmes that support the local community in the form of initiatives and funds.	✓	✓
CE-3	FCC NAP; daa NMP	*Noise and Flight Track Monitoring System* – Enables the analysis of aircraft movements to assess whether they are operating within defined corridors. The primary objective of the Noise and Flight Track Monitoring System is to gather information on aircraft approach and departure routes and resultant noise levels at several key locations. This information is used by daa to respond to any complaints relating to aircraft noise. Continue to promote enhancements of the system to include near live-flight reporting and appropriate additional fixed and/or mobile noise monitoring terminals.	✓	✓
CE-4	FCC NAP; daa NMP	*Noise Complaint Management Systems* – Process and respond to all aviation-related noise complaints in a timely manner.	✓	✓

NOTES:
daa NMP – daa Noise Management Plan
dB – Decibels
FCC NAP – Fingal County Council Noise Action Plan
HR – Hour
IAA ATC – Irish Aviation Authority air traffic control
ICAO – International Civil Aviation Organization
ILS – Instrument Landing System
KT –knots
L_{Aeq} –equivalent average sound level
LAP - - Local Area Plan
SOURCES: Fingal County Council, *Noise Action Plan for Dublin Airport – 2019 to 2023*, December 2018; daa, *Noise Management Plan*, May 2018; Irish Aviation Authority, *Dublin Airport Aeronautical Information Publication*, Section 2.21, November 5, 2020; Fingal County Council, *Dublin Airport 2020 Local Area Plan*, January 2020; Fingal Development Plan 2017-2023 Variation No. 1, December 9, 2019; An Bord Pleanála Reference Number PL06F.217429, 2007.

2.1.3 FORECAST TRAFFIC AND FLEET MIX

In March 2020 it became apparent that the COVID-19 crisis was having a significant impact on global aviation. The immediate effects were severe and in the short-medium term will continue to manifest themselves in reduced air traffic demand in Ireland and globally. One forecast year was evaluated to account for conditions when air traffic movements accommodate passenger levels of 32 mppa after the North Runway is opened without Condition 3(d) and 5 in place. The updated forecast accounted for impacts of COVID-19 and determined passenger levels will reach 32 mppa in 2025.[22]

Forecast flight movements include assumptions related to airline plans to replace older aircraft with newer aircraft that meet Chapter 4 or Chapter 14 noise certification standards. Refer to the *Dublin Airport Operating Restrictions Quantification of Impacts on Future Growth* by Mott MacDonald for more information on assumed improvements on aircraft technology and expected pace of fleet replacement.[23]

Forecast movement demand and use of quieter aircraft for 2025 was evaluated and included in the noise modelling assessments. The forecast movements were based on an unconstrained condition where Conditions 3(d) and 5 are not in place. Any potential movement constraints caused by the 32 mppa passenger capacity limit are not expected to occur until after 2025. The unconstrained forecast movements for 2025 was applied for not only the Forecast without New Measures scenario, but also the additional mitigation measure scenarios.

The scenario that includes the two runway operating restrictions is called the Permitted Operation Situation scenario. This scenario maintains the North Runway operating restriction (Conditions 3(d) and 5) and assumes constrained forecast movements for 2025 due to the North Runway operating restrictions. This scenario is compared to the Forecast including Additional Measures to assess cost-effectiveness between the two. The comparison results are summarised in Section 4 and more details are provided in the *Dublin Airport North Runway, Regulation 598/2014 (Aircraft Noise Regulation) Cost Effectiveness Analysis* report by Ricondo & Associates, Inc.

Table 2-2 lists the forecast unconstrained annual average and summer's day movements by aircraft type for 2025 used to model the Forecast without New Measures scenario and other potential scenarios that include new mitigation measures. The annual counts are reported for the annual average and the summer's day. The annual average is used to calculate the day-evening-night noise level (L_{den}) and night noise level (L_{night}).[24,25] The summer's day movements are used to calculate the summer 16-hour average daytime sound level ($L_{Aeq,16hr}$). As previously stated, the forecast did account for operator replacement of older and louder aircraft over the years. Examples of new aircraft are the Airbus A-320neo, Airbus A-321neo, Airbus A350, the Boeing 737-MAX and the Boeing 787. For purposes of this Aircraft Noise Regulation assessment, the Boeing 737-MAX was assumed to be back in operation by 2022. The growth forecast compound annual growth rate in movements between 2022, when the North Runway opens, and 2025 is 1.7 percent.

[22] Mott MacDonald, *Dublin Airport Operating Restrictions - Quantification of Impacts on Future Growth September 2020 Update 2022 2025 Period*, Draft version 5.3, September 2020.

[23] Mott MacDonald, *Dublin Airport Operating Restrictions - Quantification of Impacts on Future Growth September 2020 Update 2022 2025 Period*, version 5.3, September 2020.

[24] Day-evening-night level is an A-weighted decibel (dBA) descriptor of noise level based on energy equivalent noise level (L_{eq}) over a whole day with a penalty of 10 dBA for night-time noise (2300-0700) and an additional penalty of 5 dBA for evening noise (i.e. 1900-2259).

[25] Night noise level is the A-weighted decibel (dBA), L_{eq} (equivalent noise level) over the 8-hour night period of 2300 to 0700 hours, also known as the night noise indicator.

TABLE 2-2 AVERAGE ANNUAL AND SUMMER'S DAY MOVEMENTS BY AIRCRAFT TYPE - 2025 UNCONSTRAINED FORECAST

	ANNUAL AVERAGE				SUMMER DAY		
AIRCRAFT TYPE	ANNUAL DAY	ANNUAL EVENING	ANNUAL NIGHT	ANNUAL 24HR	SUMMER DAY 16HR	SUMMER NIGHT	SUMMER 24HR
Airbus A306	325	0	976	1,301	90	270	360
Airbus A319	1,952	651	976	3,579	721	270	991
Airbus A320	40,349	10,087	9,111	59,547	13,975	2,524	16,499
Airbus A320neo	7,484	1,952	976	10,412	2,615	270	2,885
Airbus A321	3,254	0	0	3,254	902	0	902
Airbus A321neo	2,603	0	1,302	3,905	721	361	1,082
Airbus A330	11,714	0	1,302	13,016	3,246	361	3,607
Airbus A350	325	0	325	650	90	90	180
ATR 42	2,278	325	0	2,603	721	0	721
ATR 72	15,293	2,278	651	18,222	4,869	180	5,049
Boeing 737-400	0	1,627	976	2,603	451	270	721
Boeing 737-700	2,929	1,302	325	4,556	1,172	90	1,262
Boeing 737-800	49,785	15,293	10,413	75,491	18,032	2,885	20,917
Boeing 737 MAX	8,460	4,555	651	13,666	3,606	180	3,786
Boeing 767	0	325	325	650	90	90	180
Boeing 777	651	0	651	1,302	180	180	360
Boeing 777X	0	651	0	651	180	0	180
Boeing 787	5,857	0	1,302	7,159	1,623	361	1,984
Bombardier CS300	1,952	0	0	1,952	541	0	541
Bombardier Dash 8	1,952	651	0	2,603	721	0	721
Embraer E190/195	5,857	976	325	7,158	1,893	90	1,983
Other	4,230	1,627	651	6,508	1,623	180	1,803
Total	**167,251**	**42,301**	**31,238**	**240,788**	**58,063**	**8,655**	**66,714**

NOTE: Total values may not add up due to rounding.

SOURCE: Bickerdike Allen Partners LLP, *Dublin Airport North Runway Noise Information for the Regulation 598/2014 (Aircraft Noise Regulation) Assessment*, November 2020.

Table 2-3 shows the number of annual average and summer's day movements by daytime, evening, and night-time hours for 2025. The time of day distribution provides an indication on the influence evening and night-time movements have on the L_{den} metric, which weights evening and night-time noise events.

TABLE 2-3 AVERAGE ANNUAL AND SUMMER'S DAY MOVEMENTS BY TIME OF DAY – UNCONSTRAINED 2025 FORECAST

	ANNUAL AVERAGE				SUMMER		
OPERATION MODE	DAYTIME	EVENING	NIGHT-TIME	TOTAL	DAYTIME	NIGHT-TIME	TOTAL
Aircraft Movements	167,251	42,301	31,238	240,788	58,063	8,655	66,714
Percentage of Total Movements	69.4%	17.6%	13.0%	100.0%	87.0%	13.0%	100.0%

NOTES:
Totals may not add up due to rounding
Daytime – 0700 to 1900
Evening – 1900 to 2300
Night-time – 2300 to 0700
Summer Day – 0700 to 2300
SOURCE: Bickerdike Allen Partners LLP, *Dublin Airport North Runway Noise Information for the Regulation 598/2014 (Aircraft Noise Regulation) Assessment*, November 2020.

2.1.4 FORECAST RUNWAY USE

Forecast runway use for the Forecast without New Measures scenario assumes preferential runway use described in Conditions 3(a) through 3(c) in the *North Runway Planning Permission* document (measure NA-9 in Table 2-1) between 0700 and 2259. Conditions 3(a) through 3(c) state the following:

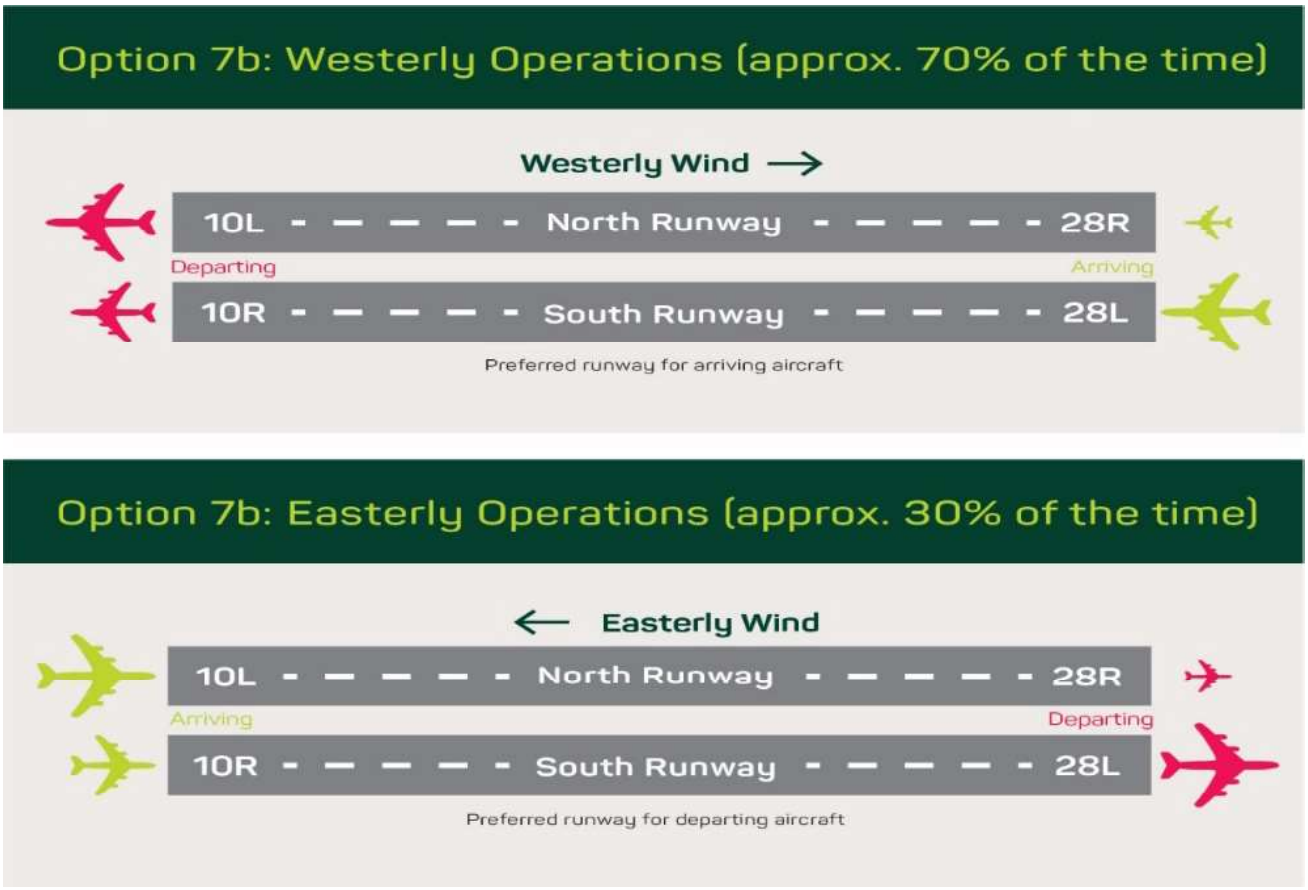
> *On completion of construction of the runway hereby permitted, the runways at the airport shall be operated in accordance with the mode of operation – Option 7b – as detailed in the Environmental Impact Statement Addendum, Section 16 as received by the planning authority on the 9th day of August, 2005 and shall provide that –*
>
> *(a) the parallel runways (10R-28L and 10L-28R) shall be used in preference to the cross runway, 16-34,*
>
> *(b) when winds are westerly, Runway 28L shall be preferred for arriving aircraft. Either Runway 28L or 28R shall be used for departing aircraft as determined by air traffic control,*
>
> *(c) when winds are easterly, either Runway 10L or 10R as determined by air traffic control shall be preferred for arriving aircraft. Runway 10R shall be preferred for departing aircraft, and*
>
> *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.*[26]

Option 7b will be achieved primarily by a segregated mode of operation as follows and illustrated in **Exhibit 2-1**:

- When winds are westerly (approximately 70 percent of the time), Runway 28L shall be preferred for arriving aircraft. Runway 28R shall be used for departing aircraft.
- When winds are easterly (approximately 30 percent of the time), Runway 10R shall be preferred for departing aircraft. Runway 10L shall be used for arriving aircraft.

[26] Fingal County Council Ref: F04A/1755/E1, An Bord Pleanála Reference Number PL06F.217429.

EXHIBIT 2-1 OPERATING MODE OPTION 7B



SOURCE: daa, August 2020.

When the North Runway is operational, the parallel runways will predominately be operated in segregated mode during the daytime, i.e., one runway for all arrivals, the other for all departures. However, in peak periods, the runways will operate in semi-mixed mode, i.e., one runway used for both arrivals and departures simultaneously and the other runway for arrivals or departures depending on the wind direction.

The Forecast without New Measures assumes Option 7b between 0700 and 2259 and fully mixed mode runway movements during the night-time period between 2300 and 0659. The fully mixed mode runway operating condition would take place at night. This represents the most flexible runway operating condition during the night-time hours and places no preference on runways based on reducing noise for noise-sensitive areas. During mixed mode, the choice of runway for departures is based on the flight's destination. Arrivals are split equally between the two runways unless this exceeds the single-runway capacity for a given hour. If single-runway capacity is exceeded, then arrivals are moved to the other runway. In addition, the crosswind runway (Runway 16-34) is limited to occasional essential use for all hours of a day (Condition 4 of the North Parallel Runway Planning Permission remains in place). When using the North Runway most aircraft will not use the full length on departure, and instead join the runway from the first intermediate taxiway. The exceptions are Code E and

Code F aircraft,[27] which will use the full runway length. All departures on the existing South Runway will use the full runway length.

Tables 2-4 provides a summary of the average annual runway use percentage forecast for the Forecast without New Measures scenario for 2025. Refer to the *Dublin Airport North Runway, Noise Information for the Regulation 598/2014 (Aircraft Noise Regulation) Assessment* report by Bickerdike Allen Partners LLP for more details related to the runway use noise modelling assumptions for the Forecast without New Measures scenario.

TABLE 2-4 AVERAGE ANNUAL RUNWAY USE – FORECAST WITHOUT NEW MEASURES SCENARIO - 2025

	10L	10R	28L	28R	16	34	TOTAL
Daytime	**11.54%**	**8.60%**	**20.76%**	**27.86%**	**0.52%**	**0.17%**	**69.46%**
Arrival	9.52%	9.44%	22.80%	22.99%	0.49%	0.16%	65.41%
Departures	13.56%	7.76%	18.73%	32.73%	0.55%	0.18%	73.51%
Evening	**2.68%**	**2.41%**	**5.82%**	**6.48%**	**0.13%**	**0.04%**	**17.57%**
Arrival	2.78%	2.78%	6.72%	6.72%	0.14%	0.05%	19.19%
Departures	2.59%	2.04%	4.92%	6.24%	0.12%	0.04%	15.94%
Night-Time	**1.90%**	**1.86%**	**4.49%**	**4.59%**	**0.10%**	**0.03%**	**12.97%**
Arrival	2.23%	2.23%	5.39%	5.39%	0.12%	0.04%	15.40%
Departures	1.57%	1.49%	3.59%	3.78%	0.08%	0.03%	10.54%
Total	**16.13%**	**12.87%**	**31.07%**	**38.93%**	**0.75%**	**0.25%**	**100.00%**
Arrival	14.54%	14.46%	34.90%	35.10%	0.75%	0.25%	100.00%
Departures	17.71%	11.29%	27.24%	42.76%	0.75%	0.25%	100.00%

NOTES:
Totals may not add up due to rounding
Daytime – 0700 to 1859
Evening – 1900 to 2259
Night-time – 2300 to 0700
SOURCE: Bickerdike Allen Partners LLP, November 2020.

2.1.5 FORECAST TAKE-OFF AND APPROACH ROUTES

The Forecast without New Measures scenario assumes the same noise preferred departure routes consulted on and finalised through the safety assessment process. The NPRs selected, following the consultation process and safety assessment, routes departing aircraft straight out on the South Runway. North Runway departures to the west diverge to the north by either 30 degrees or 75 degrees. North Runway departures to the east diverge to the north by 15 degrees. The NPRs are considered an existing measure, identified as NA-10 in Table 2-1, for purposes of this Aircraft Noise Regulation assessment. Approach routes near Dublin Airport are all straight into the runway and do not join the final approach closer than 6 nautical miles from touchdown as indicated by the

[27] The International Civil Aviation Organization Aerodrome Reference Code is a two-part categorisation of aircraft types which simplifies the process of establishing whether a particular aircraft can use a particular airport. It is included in ICAO Annex 14. It has two 'elements', the first is a numeric code based on the Reference Field Length for which there are four categories and the second is letter code based on a combination of aircraft wingspan and outer main gear wheel span. Code E are aircraft with a wingspan between 52 and less than 65 meters and an aircraft outer main gear wheel span between 9 and less than 14 meters. Code F are aircraft with a wingspan between 65 and less than 80 meters and an aircraft outer main gear wheel span between 14 and less than 16 meters.

existing NA-4 measure related to visual approaches. Aircraft operators are requested and encouraged to follow a descent path that will ensure the aircraft is no lower than the approach path that would be followed using the Instrument Landing system (ILS) glide path, which is a three-degree descent angle.

Exhibit 2-2 shows the generalised noise model tracks representing the forecast traffic patterns for the three-runway condition when in segregated and mixed mode. The noise model tracks represent the forecast average aircraft traffic location. The average noise model track is also known as the centre or "backbone" of the traffic flow it represents. Dispersion is expected along each traffic flow and is modelled for each noise model track but is not shown the Exhibit 2-2 for clarity. These noise model tracks are applied to all noise mitigation measures that did not involve a change in flight procedure.

The following sections provide an overview of the noise model tracks developed for the three-runway condition. The noise model tracks are applicable to the Forecast without New Measures and to all other scenarios. Utilisation of the tracks will vary based on runway use assumptions for individual scenarios. Refer to the *Dublin Airport North Runway, Noise Information for the Regulation 598/2014 (Aircraft Noise Regulation) Assessment* report by Bickerdike Allen Partners LLP for more details related to the noise model flight track development and assumptions for the Forecast without New Measures scenario.

2.1.5.1 ARRIVAL TRACKS

Arrival traffic has been modelled as approaching along a glide slope of 3 degrees. Arrivals routes for the existing South Runway have been modelled using the current routes. Arrival routes have been created for the North Runway which broadly replicate those for the South Runway.

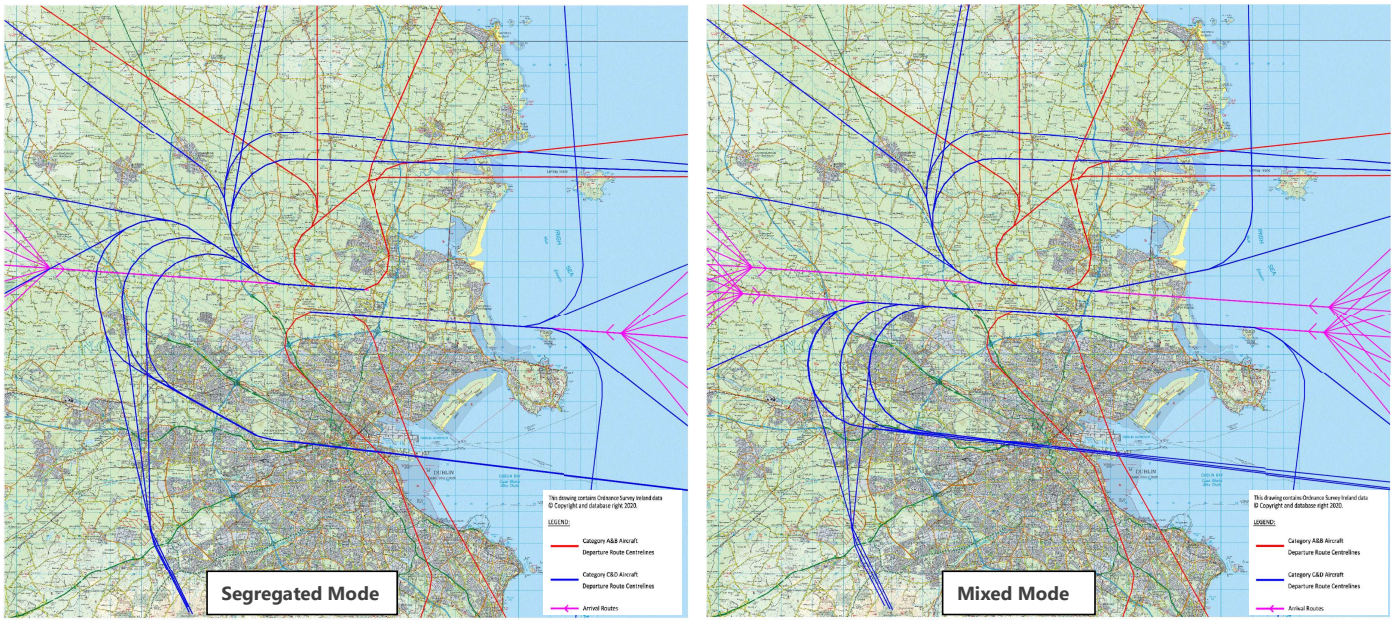
2.1.5.2 DEPARTURE TRACKS

To achieve a safe minimum separation between flights from the two main runways when both are in operation, departure noise model tracks are designed to include a course divergence of at least 15 degrees. This means that the departure routes from the two main runways differ in course (head in different directions) by at least 15 degrees. This and the NPR corridors previously described are considered when developing the noise model departure tracks.

Category A and B aircraft[28] will turn off the extended runway centreline shortly after the departure end of the runway, along a bearing that diverges away from the other parallel runway. The current routes from the South Runway would be maintained with the exception of turns to the north. From the North Runway the noise model tracks are designed to replicate the current routes from the South Runway to a large extent but with no turns to the south.

[28] The International Civil Aviation Organization designates aircraft into categories based on approach speeds. Category A aircraft are small single engine aircraft with initial approach speeds between 90 and 150 knots. Category B aircraft are small multi-engine aircraft with initial approach speeds between 120 to 180 knots.

EXHIBIT 2-2 GENERALISED NOISE MODEL FLIGHT TRACKS FOR SEGREGATED AND MIXED MODE



SOURCE: Bickerdike Allen Partners LLP, *Dublin Airport North Runway Noise Information for the Regulation 598/2014 (Aircraft Noise Regulation) Assessment,* November 2020.

As previously described, the departure noise model tracks for Categories C and D aircraft[29] are developed to represent the preferred NPR corridors. For the easterly runway operating configuration, departures from the South Runway would stay on runway heading and departures from the North Runway would turn left 15 degrees. Departures from both would not begin to turn until just over one nautical mile from the runway end. Under the westerly runway operating configuration, departures from the North Runway assigned to DEXEN, INKUR, NEPOD, PELIG and SUROX waypoints[30] or airspace fixes would turn 30 degrees to the right, while those to ABBEY and ROTEV location points would turn 75 degrees to the right, all at just over one nautical mile from the end of the runway. Departures on the South Runway would continue along the extended runway centreline before turning. Because there are no restrictions to runway use under the Forecast without New Measures scenario, all the noise model tracks shown on Exhibit 2-2 can be used during all times of the average annual day modelled.

2.1.5.3 DISPERSION

In practice, a standard operating procedure defined by a Standard Terminal Arrival Route (STAR) or Standard Instrument Departure (SID)[31] are not followed precisely by all aircraft allocated to a noise model track that represents the procedure. The actual pattern of departing aircraft is dispersed about the route's centreline and can vary as soon as an aircraft lifts off a runway. Arriving aircraft are also dispersed until aircraft join the straight-in final approach. Once aircraft are on the final approach path, there is very little dispersion left or right of the path.

The degree of dispersion is normally a function of the distance travelled by an aircraft along the route and on the form of the route (e.g., degree of turn). 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. ECAC.CEAC Doc 29 4th Edition *Report on Standard Method of Computing Noise Contours around Civil Airports* advises the use of seven "dispersed" tracks associated with each traffic flow to be modelled. This results in a series of noise model tracks that include the backbone and the three sub-tracks either side of the backbone.

2.1.5.4 NOISE MODEL TRACK USE

Air traffic control assigns a flight to STAR or SID based on the flight's origin or destination, respectively. Flight movements are assigned to each track linked to STAR or SID based on the destination or origin provided in the forecast movement schedule for 2025.

2.1.6 NOISE IMPACT OF FORECAST WITHOUT NEW MEASURES

Table 2-5 indicates the number of people forecast to be highly annoyed (HA) based on modelled 45 dB L_{den} or higher results and number of people forecast to be highly sleep disturbed (HSD) by night-time noise based on the 40 dB L_{night} or higher results. The Forecast without New Measures includes the existing and planned residential sound insulation schemes identified as LU-4 and LU-5 in Table 2-1. As previously stated, the modelled

[29] The International Civil Aviation Organization designates aircraft into categories based on approach speeds. Category C aircraft are jet aircraft with initial approach speeds between 160 and 240 knots. Category D aircraft are large jet aircraft with initial approach speeds between 185 to 250 knots.

[30] A waypoint is a specified geographical location used to define an area navigation route or the flight path of an aircraft employing area navigation. It is most often used to indicate a change in direction, speed, or altitude along the desired path.

[31] A Standard Instrument Departure Route (SID) is a standard air traffic route identified in an instrument departure procedure by which aircraft should proceed from take-off phase to the en-route phase. A Standard Arrival Route (STAR) is a standard air traffic route identified in an approach procedure by which aircraft should proceed from the en-route phase to an initial approach fix. SIDs and STARs aid in expediting the safe and efficient flow of air traffic operating to and from the same or different runways at an airport by standardising procedures. SIDs and STARs are designed to deconflict potentially conflicting traffic by the use of specific routings, levels, speed restrictions and check points. The flight crew shall comply with published SID and STAR unless cancelled or amended by an air traffic controller.

night-time noise levels for population residing in dwelling units eligible under the existing and planned schemes located were reduced by 5 dB to account for the sound insulation reduction effect which is the expected noise reduction for the schemes. The noise modelling analysis reduced the number of people exposed to night-time noise levels by 5 dB but does not reduce the modelled exterior levels for the dwelling unit.

The benefit of the residential sound insulation schemes is permitted by reducing the assessed interior noise level for treated properties. This is based on testing carried out in a sample of the properties treated under the existing scheme and where reductions of at least 5 dB in the internal noise level has been achieved in almost all cases. Therefore, dwellings eligible for the existing scheme or exposed to at least 63 $dBL_{Aeq,16hr}$ in a future scenario have been considered here as having a reduction of 5 dB for both their L_{den} and the night component of their L_{night} exposure. While this type of analysis is useful in assessing how the internal conditions within dwellings might benefit from insulation, it does not account for external amenity areas of dwellings. Use of external amenity areas however relate primarily to daytime and evening noise levels, which are largely unaffected by the Forecast without New Measures scenario. Allowing for the benefit of the residential sound insulation schemes in general reduces the number of people assessed with potential impact to night-time noise.

TABLE 2-5 NUMBER OF PEOPLE HIGHLY ANNOYED AND HIGHLY SLEEP DISTURBED – FORECAST WITHOUT NEW MEASURES

YEAR	NUMBER OF PEOPLE HIGHLY ANNOYED (HA)	NUMBER OF PEOPLE HIGHLY SLEEP DISTURBED (HSD)
2025	82,271	33,806

SOURCE: Bickerdike Allen Partners LLP, *A11267_12_CA049_14.0 Summary of Results Including Mitigation* Excel workbook, October 29, 2020.

Comparing the forecast impacts to those modelled for the 2018 situation determines whether the Forecast without New Measures scenario meets the cNAO. The year 2018 is used to represent the limiting situation referenced in the cNAO. **Table 2-6** includes the 2018 HA and HSD results and the difference between 2018 and the 2025 Forecast without New Measures scenario. As indicated in Table 2-6, the Forecast without New Measures scenario will have lower HA and HSD populations in 2025 compared to the 2018 situation.

TABLE 2-6 NUMBER OF PEOPLE HIGHLY ANNOYED AND HIGHLY SLEEP DISTURBED – COMPARISON BETWEEN FORECAST WITHOUT NEW MEASURES AND 2018

YEAR	NUMBER OF PEOPLE HIGHLY ANNOYED (HA)	NUMBER OF PEOPLE HIGHLY SLEEP DISTURBED (HSD)
2018 [1]	110,196	42,234
2025 Forecast without New Measures	82,271	33,806
2025 Forecast without New Measures Compared to 2018	**-27,925**	**-8,428**

NOTES:
Negative value indicates a decrease compared to 2018
1 2018 noise modelling results accounts for sound insulation of dwelling units based on noise mitigation measures LU-4 and LU-5 described in Table 2-1.
SOURCE: Bickerdike Allen Partners LLP, *A11267_12_CA049_14.0 Summary of Results Including Mitigation* Excel workbook, October 29, 2020.

The Forecast without New Measures scenario is expected to result in exposure to high and very high levels of night-time noise impact (55 dB L_{night} or higher) for some people in 2025.[32] **Table 2-7** provides the number of

[32] Bickerdike Allen Partners LLP., *Dublin Airport North Runway, Noise Information for the Regulation 598/2014 (Aircraft Noise Regulation) Assessment*, Section 3.3 "Significant Effects under the Scenarios," November 2020.

people exposed to 55 dB L_{night} or higher levels for 2025, number of people exposed to the same levels under the 2018 situation and a comparison between the two. The Forecast without New Measures scenario exposes fewer people to 55 dB L_{night} or higher levels in 2025 compared to the 2018 situation.

In addition to high levels of night-time noise impact, the Forecast without New Measures scenario is expected to include people forecast to experience a potential significant adverse effect caused by increases in L_{den} and/or L_{night} levels based on comparing the Forecast without New Measures for 2025 to the 2018 situation. **Exhibits 2-3** and **2-4** show the thresholds used to identify population exposed to increases compared to the 2018 situation that have the potential to cause significant adverse effects for L_{den} and L_{night}, respectively. The thresholds are based on the absolute and relative impacts that are interpreted into magnitude of effect as described in Section 3.3 of the *Dublin Airport North Runway, Noise Information for the Regulation 598/2014 (Aircraft Noise Regulation) Assessment* report by Bickerdike Allen Partners LLP.

TABLE 2-7 NUMBER OF PEOPLE EXPOSED TO 55 DB L_{NIGHT} OR HIGHER LEVELS – 2025 FORECAST WITHOUT NEW MEASURES COMPARED TO 2018

YEAR	NUMBER OF PEOPLE EXPOSE TO 55 DB L_{NIGHT} OR HIGHER
2018 [1]	548
2025 Forecast without New Measures[1]	67
2025 Forecast without New Measures Compared to 2018	-481

NOTES:
Negative value indicates a decrease compared to 2018
1 Noise modelling results accounts for sound insulation of dwelling units based on noise mitigation measures LU-4 and LU-5 described in Table 2-1.
SOURCE: Bickerdike Allen Partners LLP, *A11267_12_CA049_14.0 Summary of Results Including Mitigation* Excel workbook, October 29, 2020.

Table 2-8 provides the number of people exposed to changes in levels that equal or exceed noise level change thresholds used to indicate potential for significant adverse effects when compared to the 2018 situation. As shown in Table 2-8, the Forecast without New Measures scenario is expected to cause noise level increases that have the potential to cause significant adverse effects.

TABLE 2-8 NUMBER OF PEOPLE EXPOSED TO NOISE LEVEL INCREASES WITH POTENTIAL SIGNIFICANT ADVERSE EFFECTS – COMPARISON BETWEEN FORECAST WITHOUT NEW MEASURES AND 2018

YEAR	L_{DEN}	L_{NIGHT}
2025 Forecast without New Measures	30,186	17,981

NOTES:
1 Noise modelling results accounts for sound insulation of dwelling units based on noise mitigation measures LU-4 and LU-5 described in Table 2-1.
SOURCE: Bickerdike Allen Partners LLP, *A11267_12_CA049_14.0 Summary of Results Including Mitigation* Excel workbook, October 29, 2020.

EXHIBIT 2-3 CHANGE IN Lden NOISE LEVEL RATINGS

ABSOLUTE L_{DEN} NOISE LEVEL RATING	CHANGE IN L_{DEN} NOISE LEVEL RATING					
	NEGLIGIBLE (<1.0dB)	VERY LOW (1.0 – 1.9dB)	LOW (2.0 – 2.9dB)	MEDIUM (3.0 – 5.9dB)	HIGH (6.0 – 8.9dB)	VERY HIGH (≥9.0dB)
Negligible (<45.0dB)	Imperceptible	Imperceptible	Imperceptible	Not Significant	Slight	Moderate
Very Low (45.0 – 49.9dB)	Imperceptible	Imperceptible	Not Significant	Slight	Moderate	Significant
Low (50.0 – 54.9dB)	Imperceptible	Not Significant	Slight	Moderate	Significant	Significant
Medium (55.0 – 64.9dB)	Not Significant	Slight	Moderate	Significant	Significant	Very Significant
High (65.0 – 69.9dB)	Slight	Moderate	Significant	Significant	Very Significant	Profound
Very High (≥70.0dB)	Moderate	Significant	Significant	Very Significant	Profound	Profound

SOURCE: Bickerdike Allen Partners LLP, November 2020.

EXHIBIT 2-4 CHANGE IN Lnight NOISE LEVEL RATINGS

ABSOLUTE L_{NIGHT} NOISE LEVEL RATING	CHANGE IN L_{NIGHT} NOISE LEVEL RATING					
	NEGLIGIBLE (<1.0dB)	VERY LOW (1.0 – 1.9dB)	LOW (2.0 – 2.9dB)	MEDIUM (3.0 – 5.9dB)	HIGH (6.0 – 8.9dB)	VERY HIGH (≥9.0dB)
Negligible (<40.0dB)	Imperceptible	Imperceptible	Imperceptible	Not Significant	Slight	Moderate
Very Low (40.0 – 44.9dB)	Imperceptible	Imperceptible	Not Significant	Slight	Moderate	Significant
Low (45.0 – 49.9dB)	Imperceptible	Not Significant	Slight	Moderate	Significant	Significant
Medium (50.0 – 54.9dB)	Not Significant	Slight	Moderate	Significant	Significant	Very Significant
High (55.0 – 59.9dB)	Slight	Moderate	Significant	Significant	Very Significant	Profound
Very High (≥60.0dB)	Moderate	Significant	Significant	Very Significant	Profound	Profound

SOURCE: Bickerdike Allen Partners LLP, November 2020

2.2 BENEFITS RESULTING FROM SCENARIO IMPLEMENTATION

As previously mentioned, the Forecast without New Measures scenario revokes two operating restrictions arising, upon completion of the North Runway, under Conditions 3(d) and 5 of the planning permission granted for the North Runway (An Bord Pleanála Ref. PL06F.217429 and Fingal County Council Reg. Ref. F04A/1755), respectively. These operating restrictions place a significant constraint on the use of Dublin Airport and its runway system. The benefit to revoking the two operating restrictions is avoiding the expected impacts caused by the operating restrictions. The benefits can be categorised as follows:

- prevent constrained traffic impacts at Dublin Airport
- maintain consistency with the Irish National Aviation Policy (NAP)
- prevent forgone economic impacts for Dublin Airport and the regional and national economy

2.2.1 PREVENT CONSTRAINED TRAFFIC IMPACTS

To establish the impact of the operating restrictions, daa appointed Mott MacDonald to assess and quantify the effects on air traffic at Dublin Airport caused by the two operating restrictions. This section summarises the findings provided by Mott MacDonald.[33] The two North Runway permission conditions restrict movements during the night-time hours. Demand for flights between 2300 and 0659 is driven mainly by short haul services operated by aircraft based at Dublin Airport. Other 2300 and 0659 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).

To achieve the high levels of aircraft utilisation necessary for airline competitiveness, aircraft based at Dublin Airport must depart their first flight early in the morning and return from their last flight late at night. In addition, the geographical position of Dublin Airport and the one-hour time difference between Ireland and mainland Europe means that Dublin Airport requires longer operating days than competing European hubs due to:

- flights that need to leave early (before 0700) to arrive in time for business passengers to have a full working day at their destination
- longer sector distances to many European destinations than from other competing airports, requiring earlier departures and later arrivals
- proximity to North America compared to the rest of Europe means that transatlantic flights arrive earlier at Dublin Airport than other European airports

As a result, the peak departure period is between 0600 and 0700 and the peak arrival period for based airlines is between 2300 and midnight.

The duration of the proposed Dublin Airport night-time restrictions period, spanning eight hours from 2300 to 0700 (8 hours), is unusually broad compared to other airports with such restrictions. Average night restriction periods are typically six to six and a half hours in duration. The Dublin Airport night restrictions period is also unusual in that it includes two critical peak demand hours at Dublin Airport, from 0600 to 0700 and from 2300 to 0000. As a result, the impact of the restriction on future growth is very significant.

Demand for night-time flights before the global COVID pandemic were over 100 movements per night, with 113 movements per night associated with regularly scheduled services on a typical busy day in Summer 2019. These levels are far higher than the Condition 5 limit of 65 movements per night (measured as an average over

[33] Mott MacDonald, *Dublin Airport Operating Restrictions - Quantification of Impacts on Future Growth September 2020 Update 2022 2025 Period*, version 5.3, September 2020.

the 92-day modelling period). Demand for night-time flights is not expected to reduce significantly during the post-COVID recovery. The forecast schedules analysed for this assessment require 113 movements per night when Dublin Airport reaches 32 mppa in 2025.

The operating restriction on movements (Condition 5) and restricted use of Runway 10L-28R (Condition 3[d]) between 2300 and 0700 severely limit the long-term potential for Dublin Airport to grow as a secondary hub.

The Mott MacDonald forecast study[34] created busy day schedules for the years 2022 and 2025. The study modelled the impact of the two North Runway operating restrictions (Conditions 3[d] 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 burden of the night-time restrictions falls mainly on the Dublin Airport-based Irish carriers Aer Lingus and Ryanair. The Dublin Airport-based carriers require early morning departures and late evening arrivals for their short haul movements, and Aer Lingus requires early morning arrivals for its transatlantic movements. Carriers that are not based at Dublin Airport are less affected by the restrictions as they have fewer movements during the restricted night-time period. The operating restrictions constrain growth in short haul movements throughout the day, as the lack of night slots limits the number of Dublin Airport-based aircraft that can be accommodated, with each based aircraft performing multiple flights in and out of Dublin Airport during the operating day.

Implementing the 65 movements per night-time restriction would reduce the 2025 unconstrained scheduled forecast demand of 113 movements by 48 movements (a 43 percent reduction compared to unconstrained levels). Of the 48 displaced night-time flights, 36 (75 percent of the 48) could be potentially accommodated outside of the night-time period and 12 (25 percent) could not and were considered 'lost traffic'.[35]

In the unconstrained scenario with a return to 32 mppa there will be an operational need for the use of two runways in semi-mixed mode in peak hours.

Because the updated forecast expects demand levels to return to 32 mppa in 2025, the 32 mppa capacity limit is not expected to constrain movements until after 2025.

The assessed impact caused by the two operating restrictions is a loss of air traffic movements in the night period and associated loss of 1.1 million passengers per year (3.5 percent decrease) and a cumulative loss over the 4-year period between 2022, when the North Runway is expected to be operational, and 2025 of 4.3 million passengers. It should be noted that this estimated impact is a conservative assessment. It assumes that airlines are willing and able to accept alternative slot times outside of the night-time period, which would be commercially and/or operationally suboptimal. In a post-COVID recovery environment, weak passenger demand will mean that airline flexibility is reduced.

In summary, the Forecast without New Measures scenario would avoid the impacts associated with the operating restriction constraints as forecast demand returns to pre-COVID levels and reaches 32 mppa in 2025. Avoidance of the capacity constraints will provide Dublin Airport the ability to meet demand up to 2025 and maintain its competitiveness in the European aviation network as the travel industry recovers and continues the growth expected prior to COVID-19.

[34] Mott MacDonald, *Dublin Airport Operating Restrictions - Quantification of Impacts on Future Growth September 2020 Update 2022 2025 Period*, version 5.3, September 2020.

[35] Mott MacDonald, *Dublin Airport Operating Restrictions - Quantification of Impacts on Future Growth September 2020 Update 2022 2025 Period*, version 5.3, September 2020.

2.2.2 MAINTAIN CONSISTENCY WITH NATIONAL AVIATION POLICY

The Department of Transport, Tourism and Sport published an NAP for Ireland in August 2015. The principal goals of the NAP are:

- 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 the economic contribution of aviation sector – commit to maximising the benefits of aviation to Ireland's economic growth and development

Regarding the second runway at Dublin Airport, the NAP 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 to operate to global markets without weight restrictions is available when needed.*[36]

Results from the assessment carried out by InterVISTAS found the operating restrictions on passenger traffic and air services at Dublin Airport related to the North Runway will contradict the aims and commitments of the NAP.[37] The negative effects on both long haul and short haul flights in the constrained schedule will reduce the connectivity and competitiveness of Dublin Airport. Although growth in the short-term is updated to account for COVID-19 impacts, mid- and long-term growth is expected as the industry recovers. As demand returns and grows, the negative effects caused by the operating restrictions will occur. Revoking the two operating restrictions would seek to avoid the negative effects on flights and enhance the connectivity and competitiveness of Dublin Airport consistent with the NAP.

2.2.3 PREVENT FORGONE ECONOMIC IMPACTS

InterVISTAS was engaged by daa to conduct a study on the overall economic impact of the restrictions of the Permitted Operations scenario, building on work completed by Mott McDonald to assess and quantify the traffic impacts of the operating restrictions at Dublin Airport. In its analysis, InterVISTAS considered four distinct categories:

- Direct Economic Impact. The employment, income and economic output associated with the operation and management of activities at the airports including firms located on-site at Dublin Airport and Airport-related businesses located elsewhere.
- Indirect Economic Impact. The employment, income and economic output generated by industries that supply and support the activities at Dublin Airport, such as food wholesalers, fuel refiners, etc.
- Induced Economic Impact. The economic activity generated by the employees of firms directly or indirectly connected to Dublin Airport spending their income in the national economy.
- Catalytic Impacts. These capture the way in which Dublin Airport facilitates the business of other sectors of the economy. Air transportation supports employment and economic development in the national economy by facilitating trade, tourism, investment, and productivity growth.

The estimates of forgone economic impact in 2025 are presented in **Table 2-9**. The analysis suggests that because of the operating restrictions, the Irish economy could forgo an additional 3,430 jobs and €963 million

[36] Department of Transport, Tourism and Sport. *A National Aviation Policy for Ireland*, August 2015, Action 4.5.1, page 50.

[37] InterVISTAS, *Update Report Draft Dublin Airport Economic Impact of Operating Restrictions*, October 2020.

in GVA by 2025 (cumulative total for all three years and expressed in 2020 prices), relative to unrestricted night movements. The majority of this forgone economic impact is expected to occur outside of the aviation sector – 62 percent of the total impact is catalytic impacts (tourism, trade, investment, etc.) and another 21 percent are indirect and induced impacts (supplier and spending in the wider economy). Based on the current distribution of jobs and economic impact, it is anticipated that 83 percent of this forgone economic impact is expected to occur outside of the aviation sector (indirect, induced and catalytic impacts) and 26 percent is projected to occur in Fingal.[38]

TABLE 2-9 ECONOMIC IMPACT RESULTING FROM OPERATING RESTRICTIONS FOR 2025

FORGONE ECONOMIC IMPACT – 2025 [1]	NUMBER OF JOBS	FULL-TIME EQUIVALENTS (FTES)	WAGES (€ MILLIONS)	GVA (€ MILLIONS)
Direct Impacts	580	520	24	49
Indirect Impacts	340	300	14	27
Induced Impacts	400	360	14	28
Catalytic Impacts	2,110	1,860	81	158
Total Impacts	**3,430**	**3,040**	**133**	**262[2]**

NOTES:
GVA – Gross Value Added
All numbers in 2020 pricing
Numbers may not add up due to rounding
1 Results based on updated forecast conducted by Mott MacDonald to account for COVID-19 impacts
2 GVA total represents value just for 2025 and not cumulative between 2022 and 2025.
SOURCE: InterVISTAS, October 2020.

The cumulative impact to GVA between 2022 and 2025 was estimated at €963 million.

The Forecast without New Measures scenario would seek to remove the operating restrictions and related constraints, which will avoid the potential economic impacts caused by the constraints.

2.3 FORECAST NOISE CLIMATE

As described in Section 2.1.6, the forecast noise climate under the Forecast without New Measures scenario is expected to reduce the HA and HSD populations and those significantly impacted by night-time noise (55 dB L_{night} or higher levels), but cause increases in noise compared to the 2018 situation at levels that potentially cause significant adverse effects. There would be 30,186 people exposed to increases in L_{den} levels and 17,981 people exposed to increases in L_{night} levels compared to the 2018 situation with the potential to cause significant adverse effects. The assessment indicates the noise climate caused by the Forecast without New Measures scenario, which includes the existing and planned mitigation measures, would meet the cNAO for Dublin Airport under 2025 movement conditions, but has the potential to cause potential significant adverse effects due to increases in L_{den} and L_{night} compared to the 2018 situation. Therefore, there is a need to evaluate additional new mitigation measures to address the priority to minimise the potential to cause significant adverse effects.

[38] InterVISTAS. Dublin Airport Economic Impact of Operating Restrictions, June 2020.

2.4 FORECAST NOISE CONTOURS AND POPULATION EXPOSURE

Exhibits 2-5 and **2-6** show the L_{den} and L_{night} noise contours for 2025 Forecast without New Measures scenario, respectively. Each exhibit includes established residential, newly constructed or planned future residential locations known at the time this assessment was conducted. The 45 dB L_{den} or higher is used to calculate percentage of people HA. The 40 dB L_{night} or higher area is used to calculate percentage of people HSD. Use of both metrics and thresholds are consistent with World Health Organisation (WHO) guidelines[39] and Directive 2002/49/EC (END).[40] **Table 2-10** and **Table 2-11** indicate the population by 45, 50, 55 and 65 dB L_{den} noise exposure areas and by 40, 45, 50 and 55 dB L_{night} noise exposure areas, respectively.

TABLE 2-10 FORECAST WITHOUT NEW MEASURES POPULATION EXPOSURE – L_{DEN}

EXPOSURE LEVEL	2025 FORECAST WITHOUT NEW MEASURES POPULATION			
	ESTABLISHED RESIDENTIAL	NEWLY CONSTRUCTED PLANNED RESIDENTIAL	PLANNED FUTURE RESIDENTIAL	TOTAL
45 to 49.9 dB L_{den}	366,643	10,669	0	377,312
50 to 54.9 dB L_{den}	102,250	5,394	3,600	111,244
55 to 59.9 dB L_{den}	34,092	5,327	8,400	47,819
60 to 64.9 dB L_{den}	2,134	655	1,500	4,289
65 dB and Higher L_{den}	188	0	0	188

NOTES:
Planned Residential – approved and permitted residential development
Planned Future Residential – zoned residential land not yet permitted to be constructed
dB –decibel
L_{den} – Day/Evening/Night Noise Level
SOURCE: Bickerdike Allen Partners LLP, November 2020.

TABLE 2-11 FORECAST WITHOUT NEW MEASURES POPULATION EXPOSURE – L_{NIGHT}

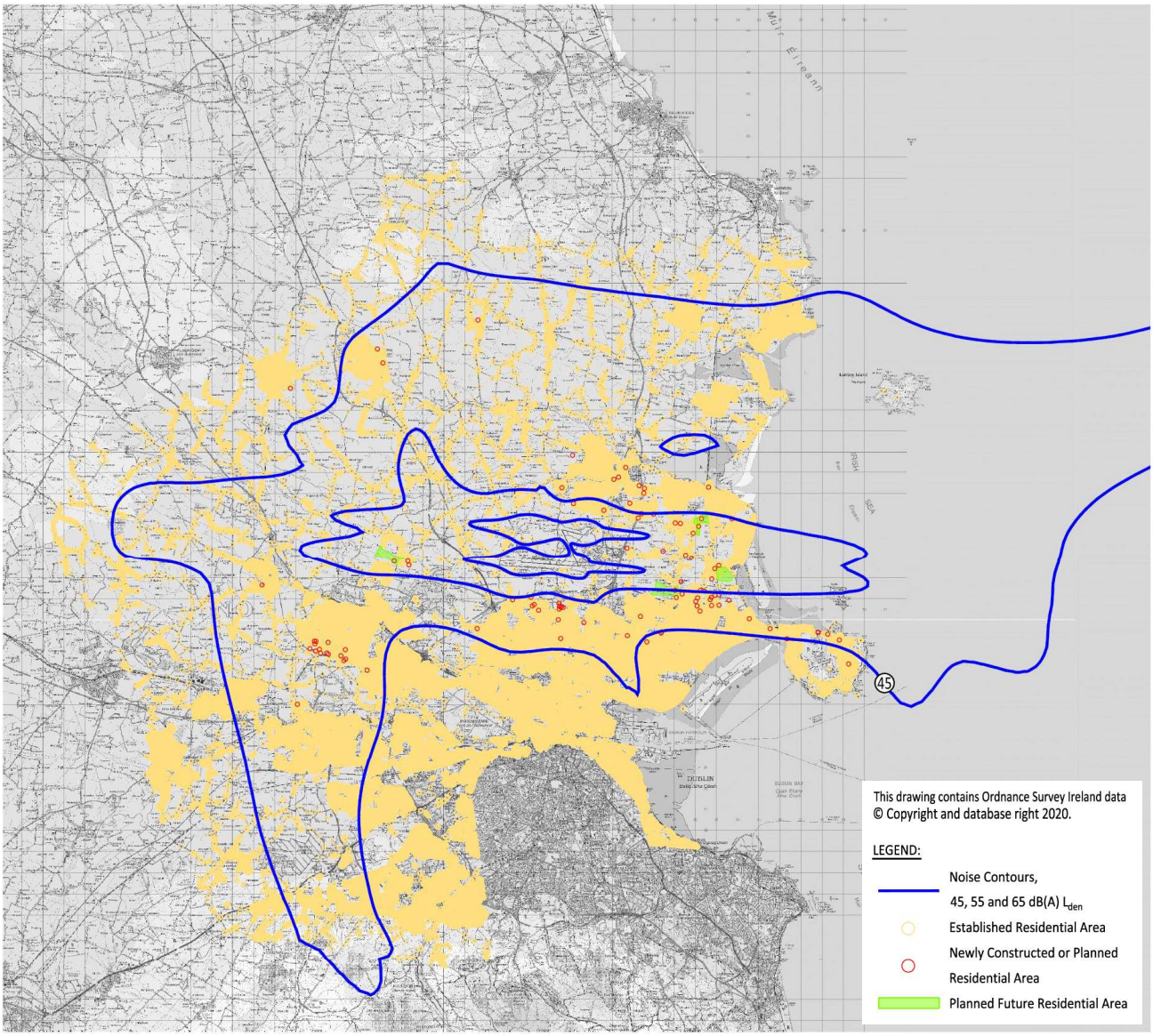
EXPOSURE LEVEL	2025 FORECAST WITHOUT NEW MEASURES POPULATION			
	ESTABLISHED RESIDENTIAL	NEWLY CONSTRUCTED OR PLANNED RESIDENTIAL	PLANNED FUTURE RESIDENTIAL	TOTAL
40 to 44.9 dB L_{night}	186,923	11,633	0	198,556
45 to 49.9 dB L_{night}	47,539	4,523	5,100	57,162
50 to 54.9 dB L_{night}	9,051	3,349	8,400	20,800
55 dB and Higher L_{night}	400	0	0	400

NOTES:
Planned Residential – approved and permitted residential development
Planned Future Residential – zoned residential land not yet permitted to be constructed
dB –decibel
L_{night} –Night Noise -time noise level (2300 to 0700)
SOURCE: Bickerdike Allen Partners LLP, November 2020.

[39] World Health Organisation, *Environmental Noise Guidelines for the European Region*, 2018, ISBN 978 92 890 5356 3

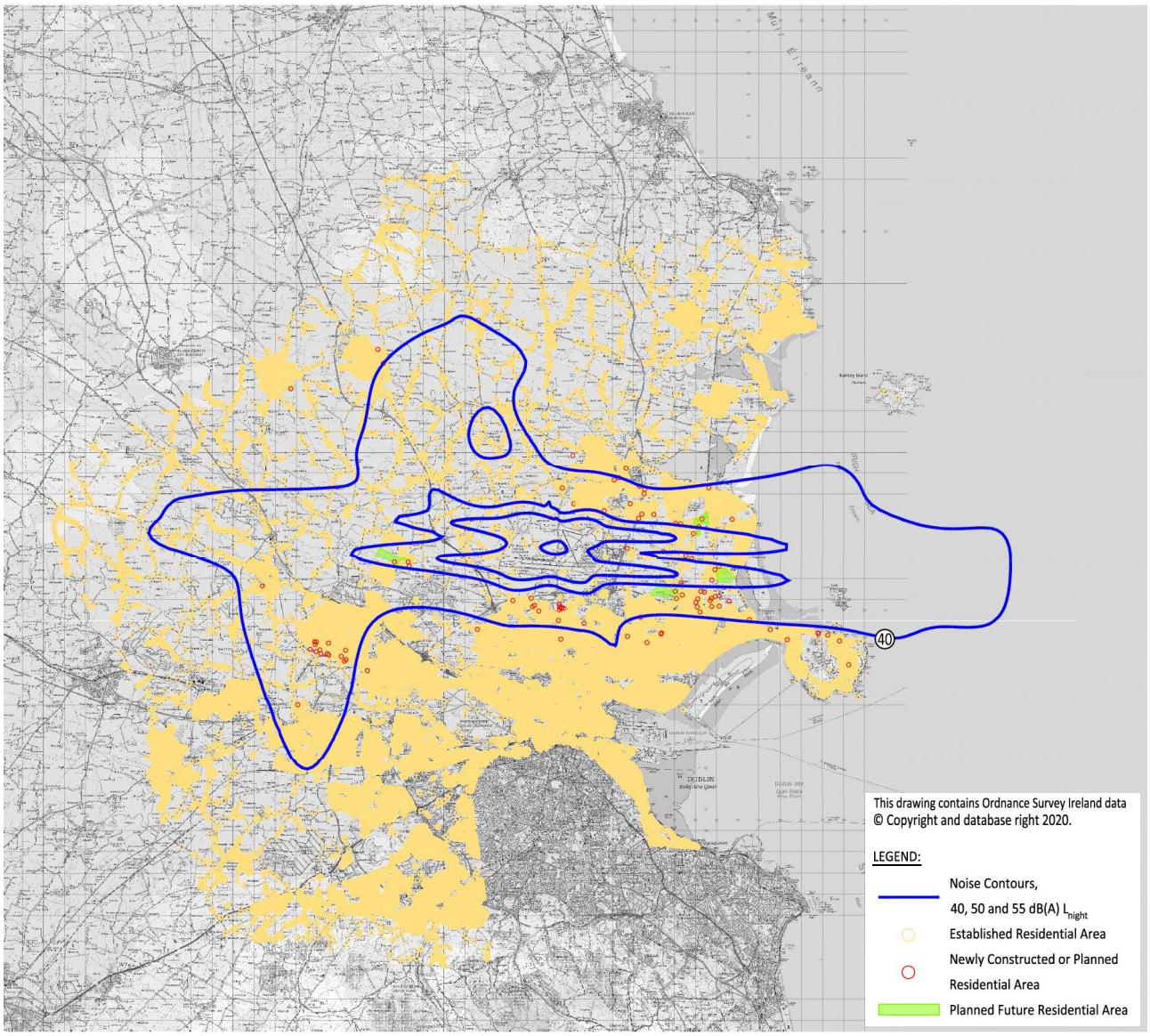
[40] Directive 2002/49/EC of the European Parliament and of the Council

EXHIBIT 2-5 FORECAST WITHOUT NEW MEASRUES L_{DEN} NOISE EXPOSURE CONTOURS - 2025



NOTES:
Newly Constructed or Planned Residential Area – approved and permitted residential development
Planned Future Residential Area – zoned residential land not yet permitted to be constructed
SOURCE: Bickerdike Allen Partners LLP, November 2020.

EXHIBIT 2-6 FORECAST WITHOUT NEW MEASRUES L_{NIGHT} NOISE EXPOSURE CONTOURS - 2025



NOTES:
Newly Constructed or Planned Residential Area – approved and permitted residential development
Planned Future Residential Area – zoned residential land not yet permitted to be constructed
SOURCE: Bickerdike Allen Partners LLP, November 2020.

2.5 CONSEQUENCES OF NOT TAKING ACTION TO REDUCE IMPACT

As stated in Section 2.3, the Forecast without New Measures scenario would meet the cNAO and is expected to cause a reduction in HSD and HA populations compared to the 2018 situation as described in Section 2.1.6. Therefore, there would be no consequences associated with effects linked to annoyance and sleep disturbance. Implementing the Forecast without New Measure would increase noise levels that could cause potentially significant adverse effects compared to the 2018 situation. There would be 30,186 people exposed to increases in L_{den} levels and 17,981 people exposed to increases in L_{night} levels compared to the 2018 situation with the potential to cause significant adverse effects. The consequences of not taking action to evaluate new additional measures would involve potential adverse effects associated with the increase in L_{night} and L_{den} levels in 2025 compared to the 2018 situation.

3. ASSESSMENT OF ADDITIONAL MEASURES

3.1 ADDITIONAL MEASURES

Noise mitigation measures are designed to reduce current and anticipated aircraft noise exposure on noise-sensitive land uses and populations without restricting movements and use of specific aircraft types. The Balanced Approach establishes a process for identifying, evaluating, and selecting mitigation measures related to noise reduction at the source, noise abatement operational procedures and land use planning and management. The Balanced Approach also recognises operating restrictions as a potential type of measure to reduce noise, which should only be considered after all other measures are found not to achieve a noise abatement objective. The Aircraft Noise (Dublin Airport) Regulation Act 2019 and the Aircraft Noise Regulation require the application of the Balanced Approach.

This section describes potential measures that could be considered in addition to the Forecast without New Measures scenario. The additional measures identified are evaluated to determine whether they meet the cNAO for Dublin Airport and address the increase in noise levels associated with the Forecast without New Measures scenario that have potential to cause significant adverse impacts compared to the 2018 situation. As reported in Section 2, new mitigation measures are needed as movements reach forecast 2025 levels. Night-time noise is a focus because the Forecast without New Measures scenario includes the revocation of the night-time operating restrictions related to Conditions 3(d) and 5 of the *North Runway Planning Permission* document, but the focus does not limit the types of mitigation measures considered in this assessment.

The types of additional noise mitigation measure options considered for Dublin Airport include:

- Noise Abatement Operational Procedures
  - use of runways: design or preferential use of runways to avoid noise-sensitive areas
  - flight departure and approach routings: design and use of flight procedures to aid in avoiding noise-sensitive areas around an airport
  - use of Departure Procedures
  - use of Approach Procedures
  - use of Reverse Thrust
  - use of Ground Based Operating Procedures
- Land Use Planning and Management (includes planning, mitigation, and financial instruments)

Reduction of noise at the source refers to the review of aircraft noise standards to ensure they reflect the current state of aircraft technology. This is achieved through implementation of noise certification standards.[41] Because this type of measure relies on updating policies and standards, this type of measure in the Balanced Approach is not within the control of individual airports. Airport operators may not have control of the noise certification standards, but they can encourage operators to use newer and quieter aircraft. Measures related to non-financial or non-restrictive means to promote use of quieter aircraft are categorised as reduction at the source measures. Financial means to promote use of quieter aircraft are considered as part of land use planning and management, which is consistent with Balanced Approach guidelines. Measures that are considered restrictive are considered operating restrictions.

[41] International Civil Aviation Organization, Doc 9829 AN 451 - *Guidance on the Balanced Approach to Aircraft Noise Management*, Amendment 1. Paragraph 4.1.2 and 4.1.4. October 10, 2010.

3.1.1 ADDITIONAL MEASURE ASSESSMENT METHODOLOGY

The intent of this assessment is to identify and assess additional measures needed to address increases in noise levels that have potential significant adverse effects associated with the Forecast without New Measures scenario while continuing to meet the cNAO. The methodology is conducted in the following steps:

1. Conduct screening assessment of potential mitigation measures.
2. Determine effectiveness of feasible measures identified in screening assessment.
3. Determine if operational restriction measures are needed to meet the cNAO and if so, conduct feasibility, effectiveness and cost-effectiveness analysis on operational restriction measures.
4. Determine cost-effectiveness of feasible measures considered effective.

The screening assessment step (Step 1) is intended to review the different types of mitigation measures available to an airport. The Balanced Approach provides a list of types that should be considered. The screening assessment reviews the types to determine if a measure type would be feasible at Dublin Airport. The types found to be feasible are retained for further assessment in defined specific scenarios.

The mitigation measure effectiveness methodology (Step 2) is designed to first evaluate measures that can affect where noise exposure levels occur, assuming the number of movements and type of aircraft remain constant. In other words, measures, such as preferential runway use and flight procedures, that would affect the overall shape and size of a noise exposure contour would be evaluated first. Effective noise abatement operational procedures are those that reduce the HA and/or HSD populations compared to the Forecast without New Measures scenario (refer to Section 2.1) and the 2018 situation. The effectiveness assessment will also evaluate the number of people potentially exposed to increases in L_{den} and L_{night} levels that have potential to cause significant adverse effects. Those noise abatement procedure measures with the lowest potential for significant adverse effects will be evaluated on their effectiveness to mitigate residual high levels of night-time noise exposure (55 dB L_{night} and higher), and if necessary consider land use planning and management measures to reduce the number of people exposed to high impact levels of night-time noise.

If the cNAO is not met after a preferred set of mitigation measures are selected, then the next step (Step 3) is conducted to assess the need for operating restrictions. The cNAO is expected to be met based on the Forecast without New Measures scenario assessment in Section 2, but operating restriction measures were considered as long as they did not restrict capacity up to 32 mppa or prevent specific aircraft using Dublin Airport in 2025. Operating restrictions that do not restrict capacity were considered as a means to ensure that the actual noise situation in 2025 will be similar to the preferred scenario with additional noise mitigation measures using the forecasted fleet mix and proposed night time runway mode of operation.

The costs to implement those measures found to be effective are estimated and used to assess cost-effectiveness of those measures (Step 4). Refer to the *Dublin Airport North Runway, Regulation 598/2014 (Aircraft Noise Regulation) Cost Effectiveness Analysis Report* by Ricondo & Associates, Inc. for detailed information on the cost-effectiveness methodology and results. The following subsections summarise the results of each step.

3.1.2 STEP 1 – MITIGATION MEASURES SCREENING ASSESSMENT RESULTS

This section summarises the qualitative screening analysis of modified or potential new noise abatement measures. **Table 3-1** presents a summary of the screening of the mitigation measures considered to minimise the potential significant adverse effects related to the Forecast without New Measures scenario described in Section 2.1. Although the Forecast without New Measures scenario includes existing and planned measures (refer to Table 2-1), these measures are also included in the screening assessment to provide a comprehensive list of types considered, including those not evaluated further following completion of the screening.

TABLE 3-1 (1 OF 6) NOISE REDUCTION MITIGATION MEASURES SCREENING MATRIX

CATEGORY	TYPE	DESCRIPTION	BENEFITS	DRAWBACKS	EVALUATION	RECOMMENDATION
1. Reduction at the Source						
Aircraft Noise Levels (note: a detailed assessment on fleet modernisation was conducted to assess forecast fleet expectations. The assessment did consider operator fleet renewal plans)	**Reduction at the source**	Reduce the level of noise emitted by an aircraft by changing the noise certification standards to meet current aircraft technology. This type of measure seeks to update the noise certification standards described in Annex 16.	The noise certification standards require aircraft meet certified noise level standards to ensure new technology is applied. This reduces the noise levels emanating from aircraft.	Meeting updated noise certification standards usually provide time for manufacturers and operators to incorporate the technology and purchase/lease the aircraft; therefore, the benefit of the noise reduction is not realised in the short-term. In addition, updating noise certification standards are not within control of an individual airport.	This type of measure is not within the control of daa; therefore, this measure is not further considered.	Do Not Proceed Further
	Promote use of quieter aircraft	Individual airports do not have control over noise certification standards and operator decisions on aircraft purchases or use but can promote use of quieter aircraft through non-financial incentive measures (refer to Land Use Mitigation and Management for information on financial instruments). Non-financial incentives can be recognition programmes that seek to inform the public and operators on the operator(s) that meet noise abatement best practices on a frequent basis. Such a programme can weigh the use of quieter aircraft when scoring each operator.	Non-financial incentives such as a programme promoting use of noise abatement best practices by operators has a direct effect on operator compliance, which has a direct impact on reducing noise levels at an airport.	This type of measure depends on operators reacting positively to potential public recognition for use of quieter aircraft. If a major operator at an airport does not recognise the benefit, the incentive to meet best practices will not be effective. If popular with operators, the effectiveness may vary each year depending on current economic conditions that impact an operator's ability to meet demand efficiently while also meeting best noise abatement practices.	This is a current planned measure expected to be implemented in the lifetime of the Noise Action Plan (2019-2023). The measure seeks to promote noise abatement best practices at Dublin Airport and use of quieter aircraft through incentives such as a FlyQuiet programme. See Financial instruments as part of the Land Use Mitigation and Management category for more information on economic incentives related to use of quieter aircraft. Because this is an existing measure, no further consideration is required.	Existing/Planned Measure - No Further Assessment Required
2. Noise Abatement Operational Procedures						
Flight Departure and Approach Routes	**Noise Preferential Routes (NPR)**	Defines preferred departure routes for each runway for daytime and night-time movements up to 3,000 feet.	This type of measure seeks to avoid or minimise frequent overflight of noise-sensitive areas in the vicinity of an airport.	Limiting departure headings can have an impact on runway throughput. Some noise-sensitive areas may not be avoided, which can concentrate frequent overflights over some areas.	This is a current planned measure expected to be implemented when the North Runway is completed. Based on detailed analysis and consultation with all key stakeholders by daa during 2016/17, and airspace design and safety assessments by the IAA Air Navigation Service Provider (ANSP) in 2018/19, preferred routing for departures were identified and have been used in the 598 assessment. These are 30/75 degrees for departures off Runway 28R and 15 degrees off runway 10L	Existing/Planned Measure - No Further Assessment Required
	SID/STAR Procedures	Design of SID and/or STAR procedures can include routes to avoid noise-sensitive areas. SIDs and STARS are standard procedures pilots follow to transition through a busy air traffic environment. These procedures define routes well beyond the NPR corridors and above 3,000 feet.	Use of SID and/or STAR procedures provides a standard navigation reference for pilots, routing aircraft away from noise-sensitive areas.	There are limited options for routes that ensure a straight-in stable approach. Options for design of SIDs and STARs may be limited due to air traffic control and safe separation requirements. It may not be possible to avoid some noise-sensitive areas; therefore, a preferred route can concentrate frequent overflights over some areas. In addition, SIDs and STARS designed for noise abatement can have a direct impact on efficient management of air traffic in the airspace.	Design and safety assessments of SID and STAR procedures are not within the control of daa. IAA ANSP is responsible for the design and assessment of SID and STAR procedures. In addition, daa understands that the design criteria of SID and STARs are subject to limited change. This is because the increased use of Area Navigation (RNAV) based on Performance Based Navigation (PBN) criteria is foreseen in future SID and STAR designs as part of the European Airspace Modernisation Programme. However, far-reaching changes to existing RNAV SIDs and STARs were not considered at this stage because they have been proved to be safe, efficient, and environmentally effective. As the capabilities of aircraft avionics increase and enable even more accurate track-keeping than is already achieved, review and refinements of existing procedures will endeavour to provide added benefit where possible. Because modification of SID/STAR procedures is not within the control daa and modernisation efforts are planned for Dublin Airport procedures, this measure type was not further considered at this stage.	Do Not Proceed Further

TABLE 3-1 (2 OF 6) NOISE REDUCTION MITIGATION MEASURES SCREENING MATRIX

CATEGORY	TYPE	DESCRIPTION	BENEFITS	DRAWBACKS	EVALUATION	RECOMMENDATION
Flight Departure and Approach Routes (continued)	**Dispersed Flight Tracks (Route Use)**	Dispersed flight tracks direct successive departing aircraft to different headings that cause flight tracks to operate over wide-ranging areas.	Dispersed flight tracks reduce the length and increase the width of noise exposure areas by reducing route concentration and spreading out overflights.	Dispersing traffic to a wider area will increase overflights on communities not previously exposed to aircraft noise. The use of the dispersed tracks may also be dependent upon destination or origin and may not result in an equitable distribution of flights.	Design and safety assessments of SID and STAR procedures are not within the control of daa. IAA ANSP is responsible for the design and assessment of SID and STAR procedures. In addition, daa understands that the design criteria of SID and STARs are subject to limited change. This is because the increased use of RNAV based on PBN criteria is foreseen in future SID and STAR designs as part of the European Airspace Modernisation Programme. However, far-reaching changes to existing RNAV SIDs and STARs were not considered at this stage because they have been proved to be safe, efficient, and environmentally effective. As the capabilities of aircraft avionics increase and enable even more accurate track-keeping than is already achieved, review and refinements of existing procedures will endeavour to provide added benefit where possible. Because modification of SID/STAR procedures is not within the control daa and modernisation efforts are planned for Dublin Airport procedures, this measure type was not further considered.	Do Not Proceed Further
	Route Alternation (Route Use)	Alternating use of routes provides a break or respite from aircraft overflights for noise-sensitive areas.	Route alternation manages the frequency of aircraft overflight of noise-sensitive areas, targeting a more equitable distribution among noise-sensitive areas and providing periods during each day without overflights on individual routes.	This type of measure can direct overflights on communities not previously exposed to aircraft noise. The use may also be dependent upon destination or origin and may not result in an equitable distribution of flights.	Design and safety assessments of SID and STAR procedures are not within the control of daa. IAA ANSP is responsible for the design and assessment of SID and STAR procedures. In addition, daa understands that the design criteria of SID and STARs are subject to limited change. This is because the increased use of RNAV based on PBN criteria is foreseen in future SID and STAR designs as part of the European Airspace Modernisation Programme. However, far-reaching changes to existing RNAV SIDs and STARs were not considered at this stage because they have been proved to be safe, efficient, and environmentally effective. As the capabilities of aircraft avionics increase and enable even more accurate track-keeping than is already achieved, review and refinements of existing procedures will endeavour to provide added benefit where possible. Because modification of SID/STAR procedures is not within the control daa and modernisation efforts are planned for Dublin Airport procedures, this measure type was not further considered.	Do Not Proceed Further
	Automated (RNAV) Procedures / Performance Based Navigation (PBN)	Automated SID/STAR procedures based on RNAV provides a more repeatable and predictable flight path over the ground based on global positioning satellites and advanced flight management systems in the aircraft compared to ground-based navigation.	RNAV procedures can be designed to direct aircraft over more compatible areas in a more accurate and predictable manner. This can lead to reducing the number of noise-sensitive areas overflown by aircraft.	More predictable and repeatable procedures can lead to a concentration of overflights over some noise-sensitive areas. This concentration of traffic will increase the frequency of overflights and cause an increase in noise exposure. It would increase the length of noise exposure along the flight path.	Design and safety assessments of SID and STAR procedures are not within the control of daa. IAA ANSP is responsible for the design and assessment of SID and STAR procedures. In addition, daa understands that the design criteria of SID and STARs are subject to limited change. This is because the increased use of RNAV based on PBN criteria is foreseen in future SID and STAR designs as part of the European Airspace Modernisation Programme. However, far-reaching changes to existing RNAV SIDs and STARs were not considered at this stage because they have been proved to be safe, efficient, and environmentally effective. As the capabilities of aircraft avionics increase and enable even more accurate track-keeping than is already achieved, review and refinements of existing procedures will endeavour to provide added benefit where possible. Because modification of SID/STAR procedures is not within the control daa and modernisation efforts are planned for Dublin Airport procedures, this measure type was not further considered.	Do Not Proceed Further

TABLE 3-1 (3 OF 6) NOISE REDUCTION MITIGATION MEASURES SCREENING MATRIX

CATEGORY	TYPE	DESCRIPTION	BENEFITS	DRAWBACKS	EVALUATION	RECOMMENDATION
Runways	**Preferential Runway Use**	Preferential runway use for noise abatement defines preferred runways for take-offs and landings that lead to aircraft operating over more compatible areas. This measure would address preferred runways to be used during daytime and night-time hours.	Runway use has a direct effect on where noise exposure occurs and how frequently events may occur. Preferential runways are selected to maximise the number of overflights over compatible areas whenever possible.	It is possible that a preferential runway use programme cannot avoid all noise-sensitive areas. In this case, preferential runway use could cause a higher frequency of overflights for some noise-sensitive areas under the take-off or approach path of a runways that are preferred.	A preferential runway use measure that does not limit air traffic control flexibility in using runways as needed for demand reasons between 0600 and 2259 would not impact capacity of the airfield. The preferential runway use previously identified during the North Runway assessment (Option 7b) would be feasible between 0600 and 2259. Several preferential concepts for movements between 00:00 and 0559 may provide effective reduction in night-time noise for noise-sensitive areas without impacting safe operation of the runways. These concepts were recommended for further consideration. Air traffic Control (ATC) would be able to operate such 'flexible systems although any changes should not be so frequent as to cause delays in the air or on the ground while runways are being changed.	Proceed Further
	Landing Displaced Thresholds	Design landing thresholds away from the runway end to raise approach altitudes along the final approach.	Extending the point where aircraft touch down will raise the altitude along a final approach path. Raising the altitudes can reduce the noise level on the ground by increasing the distance between the aircraft and a noise-sensitive area on the ground.	Moving the location where aircraft touchdown on a runway will reduce the available landing length, which could limit the type of aircraft that can land on the runway. Limiting the type of aircraft that can land on the runway may be deemed an operating restriction and may require significant cost to change taxiway geometry and navigational instrumentation.	The proposed North Runway includes displaced thresholds for both runway ends. Further displacement of the landing thresholds is not expected to provide much additional benefit in reducing noise levels. Increasing the displaced threshold distance will reduce available landing length and could also impact departure and arrival separation. Both could have a direct effect on runway throughput. Because the proposed runway is designed with displaced landing thresholds, this type of measure was not further considered.	Do Not Proceed Further
	Runway Use Respite / Alternate Runway Use	This is similar to a preferred runway measure but is designed to alternate from one runway to another or from one runway operating configuration to another to provide a break or respite for a specified number of hours in a noise exposure for targeted communities.	Respite runway use manages the frequency of aircraft overflight of noise-sensitive areas by providing a more equitable distribution among noise-sensitive areas and providing periods in a day that do not involve aircraft overflight noise.	This type of measure can direct overflights on communities not previously exposed to aircraft noise. The use may also be dependent upon destination or origin and may not result in an equitable distribution of flights.	A preferential runway use measure that does not limit air traffic control flexibility in using runways as needed for demand reasons between 0600 and 2259 would not impact capacity of the airfield. The preferential runway use previously identified during the North Runway assessment (Option 7b) would be feasible between 0600 and 2259. Two concepts to rotate runway use to distribute and provide respite at night were identified and considered feasible concepts for further evaluation. One was to alternate the use of the north and south runway between 0000 and 0600. The second was alternating between Option 7b (westerly arrivals use south runway and easterly arrivals use north runway; departures use opposite runway) and Reverse Option 7b (westerly arrivals use north runway and easterly arrivals use south runway; departure use opposite runway) during night-time hours (2300 and 0600). These concepts were recommended for further consideration. ATC would be able to operate such 'swap' systems although the timing for the processes would need to be considered carefully to avoid congestion on the ground (for departures) and delays in the air (for arrivals).	Proceed Further
Departure Procedure (Climb Profile)	**Noise Abatement Departure Procedure (1 or 2) and/or Thrust Managed Climbs**	A noise abatement departure procedure (NADP) is a thrust managed climb along a SID route developed by an operator in coordination with the airframe manufacturer and an airport. There are two types of NADP climb profiles: NADP 1 for NAPD 2. NADP 1 is intended to reduce noise over areas close-in to an airport and NADP 2 is intended to reduce noise over areas further away from an airport.	The NADP performance profiles can either increase altitude as quickly as possible to reduce noise levels close-in or reduce thrust levels and climb at a slower rate to reduce noise for areas farther from the runway. The preferred profile depends on the location of noise-sensitive areas seeking relief.	The specific definition of a NADP will vary by operator which can result in differences in level of noise reduction. The application of a NADP may also cause an increase in noise over noise-sensitive areas where climb thrust is restored at or above 3,000 feet.	As recommended in the Noise Action Plan, daa re-evaluated the appropriate NADP profile for Dublin Airport based on the three-runway airfield. The assessment concluded that the NADP 2 departure remains the preferred profile at Dublin Airport. This is an existing measure assumed to be in place as part of the Forecast without New Measures scenario; therefore, further assessment was not necessary.	Existing/Planned Measure - No Further Assessment Required

TABLE 3-1 (4 OF 6) NOISE REDUCTION MITIGATION MEASURES SCREENING MATRIX

CATEGORY	TYPE	DESCRIPTION	BENEFITS	DRAWBACKS	EVALUATION	RECOMMENDATION
Departure Procedure (Climb Profile) (continued)	**Continuous Climb Operations**	A continuous climb operation along a SID procedure is intended to limit interruption of the climb profile to cruise altitude. An interruption involves an aircraft proceeding to a level altitude.	A continuous climb operation provides a reduction in noise levels to noise-sensitive areas distant from an airport. A level segment in a departure procedure keeps an aircraft at a lower altitude compared to a continuous climb and involves re-application of climb thrust when cleared to climb. This application of thrust can cause higher noise levels compared to an aircraft on a continuous climb over the same area because it would be at a higher altitude.	Establishing a continuous climb profile without interruption can cause adjustments to other departure procedures and/or approach procedures that could require relocation of other procedures or redesign of an approach procedure to stay level until clear of a departure path. Changes to other procedures to accommodate a Continuous Climb Operation can cause changes in altitude or location and may impact efficient use of the airspace.	This measure is an existing measure conducted by IAA and is assumed as part of the Forecast without New Measure scenario; therefore, further assessment was not conducted. The IAA ANSP endeavours to include continuous climb segments in its departure procedures to the maximum extent possible.	Existing/Planned Measure - No Further Assessment Required
Approach Procedure (Descent Profile)	**Final Approach Profile - Steeper / Segmented Approach Procedures / GBAS**	Raise the final approach glide slope angle to a runway from 3-degrees to 3.5-degrees.	Raising the glide slope angle along the straight-in final approach path to a runway will raise the altitude along the final approach path. Raising the altitude reduces the noise level on the ground. A screening assessment was conducted, and results indicated a small benefit in reducing noise exposure levels.	Raising the glide slope angle produces a steeper descent to a runway. The change would require updating technology and/or relocation of ground-based navigation aids. The increase in glide slope angle may increase landing distance requirements due to potential higher approach speeds which could have operational implications. All of this would need to be further investigated to consider feasibility.	Due to the need for additional detailed assessments related to feasibility and the anticipated low level of benefit, this measure type was not further considered at this stage. In fact, steeper angle approaches can generate more noise.	Do Not Proceed Further
	Continuous Descent Approach (CDA)	Design descent profile along STAR approach procedure to limit interruption of the descent from cruise altitude to the point where an aircraft joins the final approach.	A CDA approach reduces noise levels by reducing thrust levels that would be needed to keep an aircraft level, reducing airframe noise levels by minimising flap application along the descent and by increasing altitudes along the approach procedure.	Establishing a continuous approach without interruption can cause adjustments to departure procedures that could require relocation of other procedures or redesign a departure procedure to stay level until clear of the approach path. Changes to other procedures to accommodate a CDA can cause changes in altitude or location of aircraft and may impact efficient use of the airspace.	This measure is an existing measure at Dublin Airport and is assumed as part of the Forecast without New Measure scenario; therefore, further assessment was not conducted. The IAA ANSP endeavours to include CDA segments in its arrival procedures to the maximum extent possible.	Existing/Planned Measure - No Further Assessment Required
	Low Power/Low Drag	Low power/low drag is the collective term used for describing the lowest noise configuration for a given speed and/or altitude during the approach. Selecting more flap than is required for a given speed will typically lead to more airframe noise, higher engine power due to greater drag and thus higher noise.	This type of measure minimises airframe noise effects for given a predictable and repeatable approach flight path.	Low power and low drag descent require a predictable and repeatable flight path to determine more accurately when flaps should be used. Visual approaches to an airport can lead to variance in flight path location based on air traffic controller issued directions, which can result in earlier flap application. Use of more predictable and repeatable flight procedures to accommodate low power / low drag descents can also lead to concentration of traffic over some noise-sensitive areas.	This measure should generally be encouraged as part of a CDA approach and is particularly applicable for RNAV designs for STARS and final approaches as part of the upcoming European Airspace Modernisation Programme. However, the overall effect is limited and the reduction in airframe noise is not readily incorporated into noise modelling; therefore, the noise levels cannot be quantified in assessing effectiveness for purposes of conducting a cost-effectiveness analysis. Because CDA is an existing measure that can encourage low drag along the approach, and the inability to quantify airframe noise effects, this measure type was not further considered.	Do Not Proceed Further

TABLE 3-1 (5 OF 6) NOISE REDUCTION MITIGATION MEASURES SCREENING MATRIX

CATEGORY	TYPE	DESCRIPTION	BENEFITS	DRAWBACKS	EVALUATION	RECOMMENDATION
Approach Procedure (Descent Profile) (continued)	**Landing Gear Deployment**	Deployment of the landing gear significantly increases aircraft drag and airframe noise and requires an increase in engine power and engine noise. Delaying deployment as much as possible, subject to safety constraints, minimises the noise effects.	Minimises airframe and engine thrust noise effects during final approach.	Delaying landing gear deployment increases the risk of a missed approach. The difference in location between current deployment and the latest point at which the gear could be deployed to ensure a safe and stable approach may not be substantially different. This would not lead to an effective means to reduce noise for a larger number of populations.	Deploying landing gear as late as possible, subject to safety requirements and minimising missed approach risk, should be encouraged. However, application of this measure is in the control of operators and the overall effect in reducing airframe noise is limited, and it is not readily incorporated into noise modelling; therefore, quantifying effectiveness is not possible for purposes of conducting a cost-effectiveness analysis. This measure was not further considered.	Do Not Proceed Further
Reverse Thrust	**Reduce Reverse Thrust Above Idle**	Reverse thrust is used to aid the deceleration of aircraft on landing using the aircraft's engines. When safe, this measure calls for limiting application of reverse thrust above idle as aircraft slows down on the runway.	Lower reverse thrust levels reduce the noise level experienced by noise-sensitive areas located along the sides of a runway.	The benefit is limited to noise-sensitive areas close to an airport. The measure is dependent on safe conditions, and application may vary by operator and equipment. Wet weather may also prevent use of the measure. As a result, application may be inconsistent.	The Noise Action Plan includes a measure to reduce the use of reverse thrust during night-time hours. Introduction of noise monitoring for reverse thrust is planned for 2020/21. Because this is an existing measure, no further consideration was required.	Existing/Planned Measure - No Further Assessment Required
Ground-based Operational Procedures	**Limit Ground Run Up Full Thrust Activity**	Limit full thrust maintenance run-ups to location, time and/or duration	Reduces the frequency of aircraft maintenance ground run ups that include full-thrust testing. Limiting ground run ups based on location, duration, thrust and/or time of day would reduce ground noise for noise-sensitive areas near an airport.	Limiting ground run ups for maintenance purposes may impact an operator's ability to operate a flight on-time if maintenance testing cannot take place prior to the flight. If aircraft maintenance does not frequently occur at an airport, the expected benefit in noise reduction would be low.	A ground run up measure currently exists for Dublin Airport. Engine test runs are not permitted between 2000 and 0700. All aircraft types may undertake testing between 0900 and 2000, and only aircraft up to Code C may undertake engine testing between 0700 and 0900. Because this is an existing measure, no further consideration was required.	Existing/Planned Measure - No Further Assessment Required
	Limit Auxiliary Power Unit (APU) Use	APU is needed to provide power to an aircraft when the engines are not in operation and external power is no connected. This ground measure seeks to voluntarily limit APU at aircraft stand.	Noise-sensitive areas located near aircraft parking areas may benefit from reduction in noise exposure levels if APU use is limited.	The benefit is limited to noise-sensitive areas close to an airport.	daa requires operators to use the Fixed Electrical Ground Power Units (FEGP) where provided to reduce emissions on the airfield. All contact stands will have FEGP by 2022. APU use is restricted at Dublin Airport, therefore no further consideration was required.	Existing/Planned Measure - No Further Assessment Required
3. Land Use Planning and Management Measures						
Planning instruments	**Comprehensive Planning**	Comprehensive land use planning coordinates development to be compatible with community goals, including goals related to aircraft noise exposure. Land use planning is generally the responsibility of local government and is not within the control of an airport operator.	Establishing compatible future land use based on long-term aircraft noise exposure levels can assist in limiting aircraft noise impacts on residential communities.	Land use planning is effective in coordinating future development but can encounter substantial hurdles related to converting existing non-compatible development to compatible use.	FCC currently maintains a land use and planning framework related to Dublin Airport. These include FCC's County Development Plan 2017–2023 (Variation No. 1) and the Dublin Airport 2020 Local Area Plan (LAP), which defines four airport noise zones and the associated objective of each zone along with an indication of the potential noise exposure from movements at Dublin Airport. The zones are based on potential noise exposure levels ($L_{Aeq,16hr}$ and L_{night}) from aircraft operating on either the new northern or existing southern runway for arrivals or departures. Because this is an existing measure, no further consideration was required.	Existing/Planned Measure - No Further Assessment Required
	Noise Zoning	Noise zones are established by local governments. Permitted land uses within a zone are based on aircraft noise levels. Zones can include noise-related building code requirements.	Noise zones provide a legal framework to coordinate long-term land use compatibility around an airport.	Existing non-compatible uses within noise zones can remain because the requirements were not in place at the time the existing use was developed. Noise zone updates typically allow non-compatible uses if present prior to enacting the updated requirements.	FCC, with daa assistance, implemented updated noise zones as part of the County Development Plan. The zones are based on potential noise exposure levels ($L_{Aeq,16hr}$ and L_{night} levels) from aircraft operating on either the new northern or existing southern runway for arrivals or departures. The focus of the noise zones is to ensure residential development compatibility with pertinent standards and guidance in relation to planning and noise. Because this is an existing measure, no further consideration was required.	Existing/Planned Measure - No Further Assessment Required
	Encroachment Management	Management and monitoring of development to prevent encroachment of incompatible land uses around airports.	Preventing additional encroachment protects the improvements to the noise climate achieved at an airport.	Encroachment management measures can require long timeframes to establish effectiveness.	An encroachment management measure under FCC control was developed as part of the current Noise Action Plan. The measure monitors noise encroachment to ensure airport noise policy is appropriately informed through Dublin Airport related land-use planning frameworks. Because this measure exists, no further consideration was required.	Existing/Planned Measure - No Further Assessment Required

TABLE 3-1 (6 OF 6) NOISE REDUCTION MITIGATION MEASURES SCREENING MATRIX

CATEGORY	TYPE	DESCRIPTION	BENEFITS	DRAWBACKS	EVALUATION	RECOMMENDATION
Mitigating instruments	**Building Codes**	Building codes can be adapted to require adequate sound insulation to be incorporated in new construction.	Adapting building codes to include sound insulation requirements ensures compatible development in a noise zone.	Building codes do not require existing buildings, especially residential, to meet updated sound insulation requirements.	FCC implemented updated noise zones as part of the County Development Plan. The focus of the noise zones is to ensure compatibility of residential development and ensuring compatibility with pertinent standards and guidance in relation to planning and noise, which include recommended building code standards to ensure compatibility. Because this is an existing measure, no further consideration was required.	Existing/Planned Measure - No Further Assessment Required
	Sound Insulation Programme	Sound insulation includes modifications to residential or educational structures (e.g. double-glaze windows and acoustic vents) to reduce interior noise levels.	With appropriate design and specification, improved sound insulation can reduce internal noise levels for noise sensitive dwellings.	Sound insulation does not mitigate exterior noise levels. The structure of the existing building can be a limiting factor.	There is an existing sound insulation programme focused on the 63 dB $L_{Aeq,16hr}$ noise exposure level. This measure is voluntary for households located within the 63 dB $L_{Aeq,16hr}$ noise contour. A scheme based on the 2016 contour and a second scheme based on the 2022 63 dB $L_{Aeq,16hr}$ noise contour is currently being implemented. A school and pre-school insulation scheme are also being implemented as part of the existing planning consent for North Runway. A modified or additional residential sound insulation programme that addresses significant impacts to night-time disturbance is a feasible measure to consider further.	Proceed Further
	Land Acquisition and Relocation	Acquisition of land through purchase by the airport operator and relocation of residences from the acquired land that are not compatible with airport noise levels.	Land acquisition and relocation assures long-term land use compatibility for an airport. Acquired land can be cleared, retained as a buffer, or re-developed for compatible use.	Land acquisition and relocation can have a substantial impact on communities if the programme involves a large number of properties. Costs to acquire a property and relocate residents may be prohibitive.	There is an existing land acquisition and relocation measure in place for Dublin Airport. Approved in 2016, this measure provides voluntary acquisition of eligible dwellings located within the predicted 69dB $L_{Aeq,16hr}$ contour. The scheme is voluntary and places no obligation on any property owner to participate. Offers to purchase will include a 30 percent premium on the current market value of the residence. Property valuations will be based on current movements at Dublin Airport and accordingly valuations will not be affected by the new runway. The scheme will remain available for three years after North Runway is operational (2025). Because this is an existing measure, no further consideration was required.	Existing/Planned Measure - No Further Assessment Required
	Noise Barriers	Noise barriers block line-of-sight between a noise source and a noise-sensitive receptor (e.g., resident). The effectiveness of reduction depends on the height of the barrier.	An effective noise barrier located between a noise source and a noise-sensitive receptor absorbs noise energy and reduces the noise energy experienced by noise-sensitive areas protected by a barrier.	Noise barriers are limited to mitigating noise to receptors very close to an airport and do not mitigate in-flight noise. The barrier may also result in visual impacts for adjacent communities.	Because of the limited effect to neighbouring noise-sensitive receptors, this measure type was not considered to be an effective means to mitigate noise related to the overall operation of the North Runway. Fencing and the profiling of the final ground level at some locations adjacent to the boundary will provide some visual barrier to the runway at some locations.	Do Not Proceed Further
Financial instruments	**Economic Incentives / Noise-Related Airport Charges**	Economic incentive measures are typically related to promoting sound insulation improvements, developing more compatible uses, or encouraging use of quieter aircraft by operators. The measures are intended to promote aircraft noise mitigation by actions implemented by residents, developers, or operators by providing a financial incentive to complete the action. Noise-related charges may also be used to help fund noise mitigation and abatement programmes.	Financial incentives to mitigate non-compatible uses or reduce noise levels at the source would reduce population noise exposure levels by reducing the interior levels, reducing number of people residing in noise-sensitive areas or reducing the noise levels by using quieter aircraft. Noise-related airport charges can help secure funding to implement and maintain noise mitigation and abatement programmes.	The effectiveness of this type of measure relies on a positive response to the incentive and multiple parties choosing to participate in the programme. Forecasting the effect can be challenging due to the uncertainty of the level of participation. Noise-related airport charges can vary each year based on operation levels, which may present challenges in forecasting available funds.	A current measure is planned that will assess and work with airline partners to introduce quieter aircraft, particularly at night, which could include consideration of incentives. Approaches to incentives under are development and are expected to be in place by 2022. Noise charges consultation is expected to commence in Summer 2020 and will continue again in November 2020 with a view to introduction of night-time charges in 2021/22. This is intended to increase the proportion of modernised aircraft at the airport and consequentially reduce the noise from aircraft movements. Because this is an existing measure, no further consideration was required. The noise modelling in the assessment did include for fleet modernisation based on conservative rates of change and without a detailed assessment of the impact of noise charges as the final charges were not set at time of the assessment.	Existing/Planned Measure - No Further Assessment Required

SOURCE: Ricondo & Associates, Inc., August 2020 (based on discussions with and documentation from daa and daa contractors).

The Evaluation column provides a brief synopsis of the issues and findings associated with each alternative and notes whether the alternative was recommended for further assessment. Mitigation measures that exist, are currently planned, or are determined not to be practical and/or safe are not considered further as feasible additional measures. The qualitative screening analysis identifies three potential additional measures that are recommended for continued evaluation: preferential runway use, respite / alternate runway use and a residential dwelling unit sound insulation scheme.

3.1.3 STEP 2 – EFFECTIVENESS OF FEASIBLE MITIGATION MEASURES

Specific scenarios designed to address night-time noise to minimise significant adverse effects are identified for each type found to be feasible in the screening assessment. These measures were analysed in greater detail to define the measures. Refer to *Dublin Airport North Runway, Noise Information for the Regulation 598/2014 (Aircraft Noise Regulation) Assessment* report by Bickerdike Allen Partners LLP for details on noise model input assumptions such as runway use. As previously discussed, the order of the assessment starts with noise abatement operational mitigation measure scenarios identified to address night-time noise impacts. Based on the screening assessment the noise abatement operational mitigation measure types are preferential runway use. Those that are found to be effective are used to assess effectiveness of the land use planning and management mitigation measure scenarios.

An additional measure found to be feasible is residential sound insulation. This is a measure under the Balanced Approach land use planning and management category and is intended to mitigate residual noise exposure impacts after a preferred cost-effective noise abatement operational procedure measure(s) is selected in order to meet the cNAO and/or address potential high level of impact related to night-time noise. Sound insulation is recognised in the Balanced Approach and by the Environmental Protection Agency (EPA) as a measure for reducing the effects of aircraft noise.[42] To determine the effectiveness of a proposed residential sound insulation measure for purposes of this assessment, all people exposed to "high" external noise levels (high noise impact levels is 55dB L_{night} or higher consistent with the thresholds discussed in Section 3.3 of the *Dublin Airport North Runway, Noise Information for the Regulation 598/2014 (Aircraft Noise Regulation) Assessment* report by Bickerdike Allen Partners LLP) have had a 5dB reduction in noise level applied to determine a residual noise assessment rating. If a medium residual noise assessment rating (L_{night} levels between 50 and 55 dB) is determined following this calculation the sound insulation is considered to have reduced the effect on a person inside the dwelling at night from a high level to a medium level of impact. This is consistent with the cNAO priorities related to assessing night-time levels that can present a potential for high levels of impact.

The 5 dB reduction is accounted for in calculating number of people highly annoyed, highly sleep disturbed and exposed to night-time levels at or higher than 55 dB L_{night}, and provides levels to compare against the Forecast without New Measures scenario and preferential runway use measure scenarios to assess effectiveness.

Table 3-2 lists the eight preferential runway use measure scenarios considered for this Aircraft Noise Regulation assessment. All eight preferential runway use measures maintain the daytime mode of runway operation in accordance with Conditions 3(a) through 3(c) associated with the *North Parallel Runway Planning Permission* document (refer to description in Section 2.1.4).[43]

[42] Environmental Protection Agency, *Guidelines on the information to be Contained in Environmental Impact Assessment Reports - DRAFT*, August 2017

[43] An Bord Pleanála Reference Number PL06F.217429/ Fingal County Council Ref: F04A/1755/E1.

TABLE 3-2 (1 OF 5) PREFERENTIAL RUNWAY USE MEASURE SCENARIOS

SCENARIO	DAY[1] – WESTERLY WINDS	DAY[1] – EASTERLY WINDS	NIGHT[2] – WESTERLY WINDS	NIGHT[2] – EASTERLY WINDS
SCENARIO 2 **Option 7b and South Runway Only between 0000 and 0559** **0700 to 2359:** 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. 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. **2300 to 2359:** 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. 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. **0000 to 0559:** Movements preferred on the South Runway only (single runway). **0600 to 0659:** 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. 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.			  	  

TABLE 3-2 (2 OF 5) PREFERENTIAL RUNWAY USE MEASURE SCENARIOS

SCENARIO	DAY[1] – WESTERLY WINDS	DAY[1] – EASTERLY WINDS	NIGHT[2] – WESTERLY WINDS	NIGHT[2] – EASTERLY WINDS
SCENARIO 3 **Option 7b for 24-Hours** **24 hours:** 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. 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.				
SCENARIO 4 **Option 7b and Reverse Option 7b between 2300 and 0659** **0700 to 2259:** 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. 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. **2300 to 0659:** When winds are westerly, Runway 28R shall be preferred for arriving aircraft. Either Runway 28L or 28R shall be used for departing aircraft as determined by air traffic control. When winds are easterly, either Runway 10L or 10R as determined by air traffic control shall be preferred for arriving aircraft. Runway 10L shall be preferred for departing aircraft.				

TABLE 3-2 (3 OF 5) PREFERENTIAL RUNWAY USE MEASURE SCENARIOS

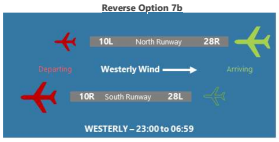
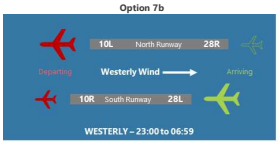
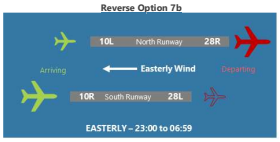
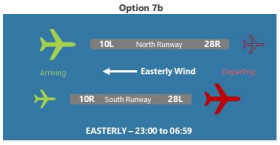
SCENARIO	DAY[1] – WESTERLY WINDS	DAY[1] – EASTERLY WINDS	NIGHT[2] – WESTERLY WINDS	NIGHT[2] – EASTERLY WINDS
SCENARIO 5 **Option 7b and Alternate Option 7b and Reverse Option 7b between 2300 and 0659** **0700 to 2259:** When winds are westerly, Runway 28L shall be preferred for arriving aircraft. Either Runway 28L or 28R shall be used for departing aircraft as determined by air traffic control. 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. **2300 to 0659:** Preferred arrival runway will alternate between North and South Runways while either Runway 28L or 28R shall be used for departing aircraft as determined by air traffic control in westerly and preferred departure runway will alternate between North and South Runways while either Runway 10L or 10R as determined by air traffic control shall be preferred for arriving aircraft in easterly wind conditions each day.			Reverse Option 7b  OR Option 7b 	Reverse Option 7b  OR Option 7b 
SCENARIO 7 **Option 7b and Semi-Mixed Mode – Mixed Mode for Departures and Option 7b for Arrivals between 2300 and 0659** **0700 to 2259:** 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. 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. **2300 to 0659:** Both North and South Runways available for departures (runway used depends on whether turn to the north or south is required based on destination); prefer arrivals landing on the South Runway in westerly conditions and the North Runway in easterly conditions unless this exceeds the single-runway capacity for a given hour. If single-runway capacity is exceeded, then arrivals are moved to the other runway.				

TABLE 3-2 (4 OF 5) PREFERENTIAL RUNWAY USE MEASURE SCENARIOS

SCENARIO	DAY[1] – WESTERLY WINDS	DAY[1] – EASTERLY WINDS	NIGHT[2] – WESTERLY WINDS	NIGHT[2] – EASTERLY WINDS
SCENARIO 8 **Option 7b and Semi-Mixed Mode – Mixed Mode for Arrivals and Option 7b for Departures between 2300 and 0659** **0700 to 2259:** 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. 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 **2300 to 0659:** Both North and South Runways available for arrivals (assumed 50/50 split); prefer departures take off on the North Runway in westerly conditions and the South Runway in easterly conditions.				
SCENARIO 9 **Option 7b and North Runway Only between 0000 and 0559** **0600 to 2359:** 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. 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. **2300 to 2359:** 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. 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. **0000 to 0559** Movements preferred on the North Runway only (single runway). **0600 to 0659:** 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. 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			  	  

TABLE 3-2 (5 OF 5) PREFERENTIAL RUNWAY USE MEASURE SCENARIOS

SCENARIO	DAY[1] – WESTERLY WINDS	DAY[1] – EASTERLY WINDS	NIGHT[2] – WESTERLY WINDS	NIGHT[2] – EASTERLY WINDS
SCENARIO 10 **Option 7b and Alternate Use of North and South Runway between 0000 and 0559** **0600 to 2359:** 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. 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. **2300 to 2359:** 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. 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. **0000 to 0559:** Alternate each night between movements on the North Runway only and the South Runway only. **0600 to 0659:** 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. 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			  OR  	  OR  

NOTES:
1. Day-time hours from 0700 to 2259
2. Night-time hours from 2300 to 0659

Scenario 6 represents the Forecast without New Measures scenario and was purposely excluded from this table
Mixed-Mode – both North Runway and South Runway can be used for arrivals and departures
Segregated Mode – one runway is used for arrivals and the opposite runway is used for departures
Single Runway – limit arrivals and departures to one runway
SOURCE: Bickerdike Allen Partners LLP, August 2020

The primary difference among the eight preferential runway use scenarios is how the runways are used during the night-time hours. Three preferential runway use scenarios (Scenarios 2, 9 and 10) provide access to both runways between 2300 and 2359, and between 0600 and 0659 (called the shoulder hours) and prefer use of one runway between 0000 and 0559. Scenario 10 suggests switching between North Runway and South Runway to provide respite between 0000 and 0559. Two preferential runway use scenarios operate in semi-mixed mode (mixed mode for arrivals or departures only) between 2300 and 0659 (Scenarios 7 and 8). One scenario maintains Option 7b for 24-hours (Scenario 3), and another proposes Reverse Option 7b during night-time hours (Scenario 4). Scenario 5 suggests alternating between Option 7b and Reverse Option 7b during night-time hours to provide respite.

Table 3-3 and **Table 3-4** provide data on the effectiveness of each preferential runway use measure scenario based on the change in HA and HSD populations compared to the 2018 situation and the Forecast without New Measures scenario, respectively. Refer to the *Dublin Airport North Runway, Noise Information for the Regulation 598/2014 (Aircraft Noise Regulation) Assessment* report by Bickerdike Allen Partners LLP related to the noise model input assumptions and population results for the 2018 situation and all the preferential runway use scenarios. The measures that would increase the HA and/or HSD populations compared to the Forecast without New Measures scenario and/or compared to the 2018 situation were not further considered in the analysis. Those additional measures that showed potential benefits were retained for further analysis. In summary, all but Scenario 7 was found to be effective in reducing the HA and HSD populations below the Forecast without New Measures scenario and the 2018 situation.

TABLE 3-3 EFFECTIVENESS OF FEASIBLE MEASURES TO ACHIEVE NOISE ABATEMENT OBJECTIVE – COMPARISON TO 2018

SCENARIO	POPULATION RESULTS		COMPARISON TO 2018 SITUATION		STATUS
	NUMBER OF PEOPLE HIGHLY ANNOYED (HA)	NUMBER OF PEOPLE HIGHLY SLEEP DISTURBED (HSD)	NUMBER OF PEOPLE HIGHLY ANNOYED (HA)	NUMBER OF PEOPLE HIGHLY SLEEP DISTURBED (HSD)	
Forecast without New Measures	82,271	33,806	-27,925	-8,428	Proceed
Scenario 2	69,255	24,429	-40,941	-17,805	Proceed
Scenario 3	66,469	21,918	-43,727	-20,315	Proceed
Scenario 4	78,946	31,967	-31,249	-10,266	Proceed
Scenario 5	79,360	30,219	-30,836	-12,014	Proceed
Scenario 7	82,913	33,858	-27,282	-8,376	Proceed
Scenario 8	68,978	23,820	-41,218	-18,414	Proceed
Scenario 9	67,783	22,586	-42,412	-19,648	Proceed
Scenario 10	69,153	24,585	-41,043	-17,648	Proceed

NOTES:

Decrease Increase

Model results include existing residential sound insulation schemes

Negative value indicates a decrease in population exposure compared to the 2018 situation.

SOURCE: Bickerdike Allen Partners LLP, *A11267_12_CA049_14.0 Summary of Results Including Mitigation* Excel Sheet, October 29, 2020 (population values).

TABLE 3-4 EFFECTIVENESS OF FEASIBLE MEASURES TO ACHIEVE NOISE ABATEMENT OBJECTIVE – COMPARISON TO FORECAST WITHOUT NEW MEASURES

SCENARIO	POPULATION RESULTS		COMPARISON TO FORECAST WITHOUT NEW MEASURES SCENARIO		STATUS
	NUMBER OF PEOPLE HIGHLY ANNOYED (HA)	NUMBER OF PEOPLE HIGHLY SLEEP DISTURBED (HSD)	NUMBER OF PEOPLE HIGHLY ANNOYED (HA)	NUMBER OF PEOPLE HIGHLY SLEEP DISTURBED (HSD)	
Scenario 2	69,255	24,429	-13,016	-9,376	Proceed
Scenario 3	66,469	21,918	-15,802	-11,887	Proceed
Scenario 4	78,946	31,967	-3,324	-1,838	Proceed
Scenario 5	79,360	30,219	-2,911	-3,586	Proceed
Scenario 7	82,913	33,858	643	52	Eliminate
Scenario 8	68,978	23,820	-13,293	-9,986	Proceed
Scenario 9	67,783	22,586	-14,487	-11,220	Proceed
Scenario 10	69,153	24,585	-13,118	-9,220	Proceed

NOTES:

Decrease Increase

Model results include existing residential sound insulation schemes

Negative value indicates a decrease in population exposure compared to the 2018 situation.

SOURCE: Bickerdike Allen Partners LLP, *A11267_12_CA049_14.0 Summary of Results Including Mitigation* Excel Sheet, October 29, 2020 (population values).

The number of people exposed to a change in noise levels compared to the 2018 situation that is considered to cause a potential significant adverse effect was evaluated for each remaining preferential runway use scenario. The preferential runway use scenario(s) that indicates the lowest total number of people exposed to significant adverse effect changes in L_{night} and L_{den} noise levels compared to the 2018 situation is selected to proceed forward in the analysis. **Table 3-5** lists the number of people exposed to noise level changes equivalent to significant adverse effects for each remaining preferential runway use scenario and indicates those eliminated from further consideration. The preferential runway use scenario with the lowest number of people exposed to changes that potentially cause significant adverse effects caused by the change in noise levels for both L_{night} and L_{den} levels is Scenario 2, which proceeds to the next step in the assessment.

Scenario 2 meets the cNAO and addresses the priority to limit potential significant adverse effects caused by increases in L_{night} and L_{den} noise levels without the addition of other measures. However, under 2025 operation conditions Scenario 2 causes an increase in the number of people exposed to 55 dB L_{night} or higher levels by 826 and 346 people compared to the Forecast without New Measures scenario and the 2018 situation, respectively. The scenario does not adequately address those people highly impacted by night-time noise. Exposure to night-time noise levels at or higher than 55 dB L_{night} are considered to cause potential for high to very high levels of impact.[44] Therefore, an additional sound insulation mitigation measure is considered to address high and very high night-time noise levels. Therefore, an additional sound insulation measure is considered to address high and very high night-time noise levels. The measure being proposed by daa is a sound insulation grant scheme for residential dwelling units exposed to levels at or above 55 dB L_{night}. This would be in addition to the existing and planned residential sound insulation measures in place.

[44] Bickerdike Allen Partners LLP, *Dublin Airport North Runway, Noise Information for the Regulation 598/2014 (Aircraft Noise Regulation) Assessment*, November 2020.

TABLE 3-5 EFFECTIVENESS OF FEASIBLE MEASURES TO MINIMISE SIGNIFICANT ADVERSE EFFECTS CAUSED BY CHANGES IN L_{DEN} AND L_{NIGHT} LEVELS – COMPARISON TO 2018

SCENARIO	NUMBER OF PEOPLE SIGNIFICANTLY ADVERSE EFFECT – L_{NIGHT}	NUMBER OF PEOPLE SIGNIFICANTLY ADVERSE EFFECT – L_{DEN}	STATUS
Scenario 2	1,529	7,949	Proceed
Scenario 3	3,206	9,023	Eliminate
Scenario 4	28,995	38,596	Eliminate
Scenario 5	19,505	28,596	Eliminate
Scenario 8	11,071	15,994	Eliminate
Scenario 9	14,647	15,143	Eliminate
Scenario 10	8,702	11,402	Eliminate

NOTES:

Decrease Increase

Model results include existing residential sound insulation schemes
Negative value indicates a decrease in population exposure compared to the 2018 situation.
L_{night} – average sound pressure level for an 8-hour period (recommended period of sleep for adults) between 2300 and 0700
L_{den} – average sound pressure for 24 hours with noise events weighted at 10 dB for night-time (2300 to 0700) and 5 dB for evening (1900 to 2300)
SOURCE: Bickerdike Allen Partners LLP, *A11267_12_CA049_14.0 Summary of Results Including Mitigation* Excel Sheet, October 29, 2020 (population values).

The proposed residential sound insulation grant scheme (RSIGS) mitigation measure applied to Scenario 2 is found to be effective in meeting the cNAO and reduce the effect of the high to very high levels of exterior noise at night. Similar to the existing and planned schemes, the analysis assumes a 5 dB reduction in effect for L_{night} and the night-time component for L_{den}. **Table 3-6** shows the effectiveness results with the proposed RSIGS measure, which indicates its effectiveness in addressing high impact levels to night-time noise. The number of people exposed to 55 dB L_{night} or higher levels inside the dwelling units is expected to be lower than the 2018 situation (548 people) and 2025 Forecast without New Measures scenario (67 people).

TABLE 3-6 EFFECTIVENESS OF SOUND INSULATION – 2025

SCENARIO	NUMBER OF PEOPLE EXPOSED TO 55 DB OR HIGHER L_{NIGHT}	CHANGE IN PEOPLE EXPOSED COMPARED TO SCENARIO 2	STATUS
Scenario 2	893	N/A	N/A
Scenario 2 with addition of 55 dB L_{night} Residential Sound Insulation Grant Scheme	62	-831	Proceed

NOTES:

Decrease Increase

Model results include existing residential sound insulation schemes
Negative value indicates a decrease in population exposure compared to Scenario 2 conditions.
dB –decibels
L_{night} – average sound pressure level for an 8-hour period (recommended period of sleep for adults) between 2300 and 0700
N/A – comparison of Scenario 2 on itself is not applicable
SOURCE: Bickerdike Allen Partners LLP, *A11267_12_CA049_14.0 Summary of Results Including Mitigation* Excel Sheet, October 29, 2020 (population values).

3.1.4 STEP 3 – NEED FOR OPERATING RESTRICTION MEASURE(S)

Scenario 2 with the addition of the 55 dB L_{night} RSIGS for people who are affected by high to very high levels of impacts at night meets the cNAO and the priority associated with reducing adverse night-time disturbance. Therefore, operating restriction measures are not necessary.

Although the alternative meets the cNAO, daa proposes to include a limitation on the use of Runway 10L-28R between 0000 and 0559 and a Quota Count (QC) measure to ensure that noise levels forecast to occur in 2025 meet the cNAO. The effectiveness of both measures is already included in the preferential runway use assumptions and forecast fleet mix. The intent of both measures is to ensure benefits of noise reduction can be achieved in 2025.

To ensure the benefits of noise reduction with the implementation of the Scenario 2 preferential runway use measure limiting use of Runway 10L-28R between 0000 and 0559, daa propose that Runway 10L-28R will not be used for take-off or landing movements between 0000 and 0559, except in cases of safety, maintenance considerations, exceptional air traffic conditions, adverse weather, technical faults in air traffic control systems, declared emergencies at other airports or where the Runway 10L-28R length is required for a specific aircraft type. Limiting use of the runway as proposed is considered a runway use operating restriction. Forecast demand through 2025 and to the 32 mppa activity level between 0000 and 0559 is relatively low and is not expected to exceed the capacity level of a single runway. Therefore, the proposed limitation is not expected to constrain aircraft movements or access at Dublin Airport, and is not expected to cause additional costs to airlines, passengers, the European air traffic system or the economy.

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 Aircraft Noise Regulation considers a QC or NQ measure as an operating restriction, but the proposed ANQ will allow growth in overall air traffic movements at night for forecast movements up to 2025 whilst ensuring that the overall effects of aircraft noise are no worse than that upon which North Runway permission was originally granted and the overall effects do not exceed those in the 2018 situation. The 32 mppa passenger capacity condition of relevant planning permission for Terminal buildings is expected to constrain overall airport activity in the 24-hour period prior to any potential constraints caused by the ANQ measure.

3.1.5 STEP 4 – COST-EFFECTIVENESS ANALYSIS ON MITIGATION MEASURES

A cost-effectiveness analysis was conducted for Scenario 2 with the addition of the 55 dB L_{night} RSIGS. The analysis is described in detail in the *Dublin Airport North Runway, Regulation 598/2014 (Aircraft Noise Regulation) Cost Effectiveness Analysis* report by Ricondo & Associates, Inc. The use limit of Runway 10L-28R and the QC measures are included with Scenario 2 preferential runway use and the 55 dB L_{night} RSIGS, but both do not involve a cost to implement and effectiveness is assumed as part of the forecast and Scenario 2 runway use. Therefore, the cost-effectiveness assessment is limited to Scenario 2 and the 55 dB L_{night} RSIGS measures.

The cumulative cost for the scenario was estimated at €2,013,525. **Table 3-7** lists the cost-effectiveness results for Scenario 2 with the addition of the 55dB L_{night} RSIGS, which is based on the cumulative estimated cost divided by the predicted reduction in HA and HSD populations compared to the 2018 situation. The cost-effectiveness

result represents the ratio of cost per person no longer considered HA or HSD with insulation measures in place through the grant scheme.

TABLE 3-7 COST-EFFECTIVENESS OF SCENARIO 2 WITH RESIDENTIAL SOUND INSULATION GRANT SCHEME COMPARED TO 2018

SCENARIO	COST-EFFECTIVENESS RATIO TO REDUCE NUMBER OF PEOPLE HIGHLY SLEEP DISTURBED (HSD)	COST-EFFECTIVENESS RATIO TO REDUCE NUMBER OF PEOPLE HIGHLY ANNOYED (HA)
Scenario 2 with addition of 55 dB L_{night} RSIGS	€112.78	€49.14

NOTES:
ANQ – Annual Night-time Quota
RSIGS – Residential Sound Insulation Grant Scheme
SOURCE: Ricondo & Associates, Inc., November 2020.

3.2 ENVIRONMENTAL AND COMPETITIVE EFFECTS

Annex I of the Aircraft Noise Regulation requires an overview of the possible environmental and competitive effects of the selected or proposed measures described in Section 3.1.3 and Section 3.1.5 on other airports, operators, and other interested parties. Because the proposed measures do not restrict movements up to a return to 32 mppa passengers at Dublin Airport or other airports, the proposed measures would not cause environmental or competitive effects on other airports, operators, and other interested parties as the airport returns to growth post COVID-19.

There would be no competitive effects because the proposed measures do not impact airfield capacity up to 2025, and would provide the following:

- Available capacity for existing operators and new entrants to schedule service as needed to compete for market demand. Unconstrained travel demands up to the exiting Terminals 1 and 2 combined capacity of 32 mppa can be met at Dublin Airport which maintains its competitiveness within the Republic of Ireland and European aviation network up to 2025.
- Maintains capacity at other airports within the Republic of Ireland and the European network to capture local market share instead of losing capacity to meet demand not met at Dublin Airport due to restrictions.

There would be no environmental effects outside of the local environment because the proposed measures do not impact airfield capacity up to 2025 and therefore would not lead to:

- Increased night-time movements at other airports within the Republic of Ireland and the European network to meet domestic and international connection demand not met at Dublin Airport due to restrictions.
- Environmental effects associated with infrastructure development to increase capacity at other airports to accommodate domestic and international connection demand not met at Dublin Airport due to restrictions.

Refer to the *Dublin Airport North Runway Relevant Action Application Environmental Impact Assessment Report* (EIAR) by AECOM Ireland Limited for information related to potential effects on the local environment if the proposed measures are implemented.

3.3 REASON FOR SELECTION OF THE PREFERRED OPTION

Based on the cost-effectiveness analysis results, the following measures comprise the Preferred Option that is recommended to be added to existing and planned noise reduction measures and implemented to amend North Runway Permitted Condition 3(d) and replace North Runway Permitted Condition 5:

- Three-Runway Preferential Runway Use
  - 0700 to 2259: 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. 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
  - 2300 to 2359: Same as preferential runway use between 0700 to 2259.
  - 0000 to 0559 – Limit take-off or landings to South Runway (Runway 10L-28R) 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 or where Runway 10R-28L length is required for a specific aircraft type. Refer to the proposed runway use limitation measure for further restrictions on the use of the North Runway between 0000 and 0559.
  - 0600 to 0659 - Same as preferential runway use between 0700 to 2259.
- RSIGS: Provide sound insulation grant for dwelling units with exterior levels at 55 dB L_{night} or higher based on forecast 2025 levels
- Runway use limitation: Runway 10L-28R shall not be used for take-off or landing between 0000 hours and 0559 hours (except in cases of safety, maintenance considerations, exceptional air traffic conditions, adverse weather, technical faults in air traffic control systems or declared emergencies at other airports or where Runway 10R-28L length is required for a specific aircraft type)
- ANQ count of 7,990 between 2330 to 0600 (NQP) to be applied for each year from the opening of the North Runway to 2025.

The reasons for selecting the new measures are their ability to minimise significant adverse effects caused by increases in L_{den} and L_{night} levels, reduce the effect of high to very high level of impacts of night-time levels for dwelling units located in exposure area at or higher than 55 dB L_{night}, and maintain HA and HSD population levels below the 2018 situation. **Table 3-8** lists all the existing, planned and recommended noise reduction measures included as part of the proposed option recommendation. The new, existing, and planned measures constitute the Forecast including Additional Measures scenario. The Relevant Action is to amend Condition 3(d) to limit use of the North Runway between 0000 to 0559 instead of between 2300 and 0659 and replace Condition 5 with ANQ between the hours of 2330 and 0600.

For purposes of the North Runway application, the Forecast including Additional Measures proposes the following Relevant Action:

- Amend Condition 3(d) so that it reads: *Runway 10L-28R shall not be used for take-off or landing between 0000 and 0559 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 or where Runway 10L-28R length is required for a specific aircraft type.*
- Replace the existing operating restriction imposed by Condition 5 with a noise quota system also known as an Annual Night Quota (ANQ) that would read: *A noise quota system for night-time noise will be introduced at the airport. The airport shall be subject to an annual noise quota of 7,990 between the hours of 2330 and 0600.*

The Forecast including Additional Measures, which includes the Relevant Actions, is referred to as the Proposed Relevant Action in the EIAR.

TABLE 3-8 (1 OF 4) EXISTING, PLANNED AND RECOMMENDED NOISE MANAGEMENT MEASURES FOR PREFERRED OPTION

MEASURE ID	SOURCE	MEASURE DESCRIPTION	2018	2025
Reduction of Noise at Source (NS)				
NS-1	FCC NAP	Promote quieter aircraft through incentives such as FlyQuiet programmes. This programme is expected to be in place by 2022.	✗	✓
NS-2	FCC NAP	Work with airline partners to introduce quieter aircraft, particularly at night, including consideration of incentives. Approaches to incentives under development and expected to be in place by 2022.	✗	✓
Noise Abatement (NA) Operating Procedures				
NA-1	FCC NAP; daa NMP; Dublin Airport Aeronautical Information Publication	*Two-Runway Preferential Runway Programme* – Intent of measure is to utilise whenever possible the runways that enable aircraft to avoid noise-sensitive areas during the initial departure and final approach phases of flight. Runway 10 or Runway 28 is the required runway between 0600 and 2300HR local time when the crosswind component is 20KT or less. Runway 28 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 10 or Runway 28 is greater than 20KT, Runway 16 or Runway 34 may become the active runway. If the forecast crosswind component on Runway 10 or 28 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. Runways will be prioritised for noise abatement purposes between 2300 and 0600HR local time, subject to the same wind calculation method and values as used between 0600 and 2300HR local time (see Section 5). When weather conditions and flight movements permit, runway usage will be prioritised as follows: Arrivals: #1 (Runway 10), #2 (Runway 16), #3 (Runway 28), #4 (Runway 34); Departures: #1 (Runway 28), #2 (Runway 34), #3 (Runway 10), #4 (Runway 16).	✓	✗
NA-2	FCC NAP; daa NMP; Dublin Airport Aeronautical Information Publication	*Two-Runway Noise Preferential Routes (NPRs) or Environmental Noise Corridors and Track Keeping* – Intent is to minimise disruption by routing aircraft away from built-up areas, where possible. Unless directed otherwise by IAA-ATC, all aircraft taking off from Dublin Airport are required to follow specific NPRs. To minimise impact, NPRs are designed to avoid overflight of built-up areas, where possible. An NPR is a path or corridor (1.8 kilometres at its widest point) that aircraft follow from take-off until being directed by IAA-ATC onto their main air traffic routes, typically at 3,000 feet altitude above mean sea level. Aircraft flying inside the NPR corridor are flying on-track. Departures from all runways (except easterly departures on the existing Runway 10/28 must maintain course straight out for 5 nautical miles (1 nautical mile = 1,852 metres) after take-off before commencing a turn, unless otherwise cleared by IAA-ATC. Easterly departures on the existing southern runway must maintain course straight out for 5 nautical miles before commencing a turn to the north, or to 6 nautical miles before commencing turn to the south. Once an aircraft reaches the end of the NPR, or at an altitude of 3,000 feet, IAA-ATC will turn it onto a more direct heading to its destination. IAA-ATC can turn aircraft off NPRs below 3,000 feet for safety reasons, for example to avoid storms.	✓	✗
NA-3	FCC NAP; daa NMP; Dublin Airport Aeronautical Information Publication	*Noise Abatement Departure Procedures (NADP) Climb Profile* – Based on noise-abatement departure climb guidance contained in the ICAO's Procedures for Air Navigation Services Aircraft Operations Document 8168 Volume 1, Flight Procedures Appendix to Chapter 3 – NADP2, with thrust cutback at 1,500 feet..	✓	✓
NA-4	Dublin Airport Aeronautical Information Publication	*Visual Approach* – Jet aircraft (Cat C/D) on visual approach to Runways 28, 10, 16, and 34 must join final approach no closer than 6 nautical miles from touchdown. Aircraft must follow a descent path that will not result in being at any time lower than the approach path, which would otherwise be followed using the ILS glide path.	✓	✓
NA-5	FCC NAP	*Continuous Decent Approach (CDA)* – Operates a CDA that reduces the noise experienced on the ground by reducing the overall thrust required during the initial descent and keeping aircraft at higher altitudes for a longer period.	✓	✓

TABLE 3-8 (2 OF 4) EXISTING, PLANNED AND RECOMMENDED NOISE MANAGEMENT MEASURES FOR PREFERRED OPTION

MEASURE ID	SOURCE	MEASURE DESCRIPTION	2018	2025
NA-6	IAA ATC	*Continuous Climb Operations* - continuous climb operation along a standard departure procedure is intended to limit interruption of the climb profile to cruise altitude and reduces the noise experienced on the ground caused by thrust levels required to keep aircraft level and increases distance from noise-sensitive areas between an aircraft and receptor as soon as possible.	✓	✓
NA-7	FCC NAP; daa NMP; Dublin Airport Aeronautical Information Publication	*Reverse Thrust* – Reverse thrust is used to aid the deceleration of aircraft on landing using the aircraft's engines. This should not be used at night, unless required for safety reasons.	✓	✓
NA-8	FCC NAP; daa NMP	*Engine Ground Running* – Engine test runs are not permitted between 2000HRs and 0700HRs. All aircraft types may undertake testing between 0900 and 2000HRs, and only aircraft up to Code C may undertake engine testing between 0700 and 0900HRs.	✓	✓
NA-9	FCC NAP; daa NMP	*Monitor and Report* – Sustain noise operating procedures through monitoring.	**Partial**	✓
NA-10	Accepted NPR for North Runway	*Three-Runway Noise Preferential Routes (NPRs) or Environmental Corridors (ECs) and Track Keeping* – Intent is to minimise disruption by routing aircraft away from built-up areas, where possible. Unless directed otherwise by IAA-ATC, all aircraft taking off from Dublin Airport are required to follow specific NPRs. To minimise impact, NPRs are designed to avoid overflight of built-up areas, where possible. An NPR is a path or corridor (1.8 kilometres at its widest point) that aircraft follow from take-off until being directed by IAA-ATC onto their main air traffic routes, typically at 3,000 feet altitude above mean sea level. Aircraft flying inside the NPR corridor are flying on-track. The preferred departure flight path NPR is straight out on the South Runway and divergence paths of 30-degrees and 75-degrees for the North Runway for westerly flow and straight out on the South Runway and a divergent path of 15-degreesd for easterly flow.	✗	✓
NA-11		*Three-Runway Preferential Runway Programme* – Intent of measure is to utilise whenever possible the runways that enable aircraft to avoid noise-sensitive areas during the initial departure and final approach phases of flight. From 0700 to 2259, 2300 to 2359 and 0600 to 0659: 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. 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. From 0000 to 0559: Limit take-off or landings to South Runway (Runway 10L-28R) 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 or where Runway 10R-28L length is required for a specific aircraft type.	✗	✓
Land Use (LU) Planning and Management				
LU-1	FCC NAP; daa NMP; FCC County Development Plan; Dublin Airport LAP	*Land Use Compatibility Management Framework* – The land use and planning frameworks include the FCC's County Development Plan 2017–2023 (Variation No. 1) and the Dublin Airport 2020 Local Area Plan (LAP); which defines four airport noise zones and the associated objective of each zone along with an indication of the potential noise exposure from movements at Dublin Airport. The zones are based on potential noise exposure levels ($L_{Aeq,16hr}$ and L_{night} levels) due to Dublin Airport using either the new northern or existing southern runway for arrivals or departures. The noise zoning system has been developed with the overarching objective to balance the potential impact of aircraft noise from Dublin Airport on both external and internal noise amenity. This allows larger development which may be brought forward in the vicinity of Dublin Airport's flight paths to be identified and considered as part of the planning process. The focus of the noise zones is to ensure compatibility of residential development and ensuring compatibility with pertinent standards and guidance in relation to planning and noise	✓	✓
LU-2	FCC NAP	*Land Use Compatibility Management Review* – Keep under review land-use policies in relation to aircraft noise through the review of existing land-use planning frameworks in so far as they relate to Dublin Airport.	✓	✓

TABLE 3-8 (3 OF 4) EXISTING, PLANNED AND RECOMMENDED NOISE MANAGEMENT MEASURES FOR PREFFERRED OPTION

MEASURE ID	SOURCE	MEASURE DESCRIPTION	2018	2025
LU-3	FCC NAP	Encroachment Management – Monitor noise encroachment associated with Dublin Airport to ensure airport noise policy is appropriately informed through land-use planning frameworks in so far as they relate to Dublin Airport.	✓	✓
LU-4	FCC NAP; daa NMP	*Sound Insulation (HSIP)* – Voluntary to households that qualify by being located within the 2016 63 dB $L_{Aeq,16hr}$ noise contour.	✓	✗
LU-5	North Runway Planning Permission Condition 7	*Sound Insulation (RNIS)* – Voluntary to households that qualify by being located within the 2022 63 dB $L_{Aeq,16hr}$ noise contour. All properties to be completed by the time North Runway is operational.	✗	✓
LU-6	North Runway Planning Permission Condition 9	*Voluntary Dwelling Purchase Scheme* – Approved in 2016, this measure provides voluntary acquisition of eligible dwellings. Eligibility for the scheme is based on the predicted 69dB $L_{Aeq,16hr}$ contour. This is the noise threshold for participation in the voluntary scheme. The scheme is completely voluntary and places no obligation on any resident to participate. Offers to purchase will include a 30 percent premium on the current market value of the residence. Property valuations will be based on current movements at Dublin Airport and accordingly valuations will not be affected by the new runway. The scheme will remain available for three years after North Runway is operational (2025).	✓	✓
LU-7	North Runway Planning Permission Condition 6	*Voluntary School Sound Insulation* - voluntary noise insulation of schools for all schools and registered pre-schools predicted to fall within the contour of 60 dB $L_{Aeq,16hr}$. The scheme is designed to ensure that maximum noise limits within the classrooms and school buildings generally shall not exceed 45 dB $L_{Aeq,8hr}$ (a typical school day).	✗	✓
LU-8		*Night-time Sound Insulation Grant Programme* – A grant programme for households that qualify by being located between the 2025 forecast L_{night} 55 dB and higher noise contours.	✗	✓
Operating Restrictions (OR)				
OR-1	North Runway Planning Permission Condition 4	Crosswind runway (16-34) shall be restricted to essential occasional use on completion of the new runway in accordance with Objective DA03 of the Fingal County Development Plan, 2005-2011. 'Essential' use shall be interpreted as use when required by international regulations for safety reasons.	✗	✓
OR-2		Runway 10L-28R "No Use" Limit: This measure is intended to ensure that noise levels forecast to occur in 2025 meet the cNAO Runway 10L-28R shall not be used for take-off or landing between 0000 hours and 0559 hours (except in cases of safety, maintenance considerations, exceptional air traffic conditions, adverse weather, technical faults in air traffic control systems or declared emergencies at other airports or where Runway 10R-28L length is required for a specific aircraft type). Due to historic and forecast low demand, this restriction is not expected to impact Dublin Airport capacity and efficiency, the European aviation system, and the economy.		
OR-3		Quota Count: This measure is intended to ensure that noise levels forecast to occur in 2025 meet the cNAO. The proposed quota count is based on an Annual Night Quota (ANQ) count of 7,990 between 2330 to 0600 (Night Quota Period) to be applied for each year from the opening of the North Runway to 2025		
Monitoring and Community Engagement (CE)				
CE-1	FCC NAP; daa NMP	*Stakeholder Engagement* – Participate in regular meetings with the Dublin Airport Environment Working Group and Community Liaison Group.	✓	✓
CE-2	FCC NAP; daa NMP	*Community Engagement Programme* – Includes newsletters and various programmes that support the local community in the form of initiatives and funds.	✓	✓

TABLE 3-8 (4 OF 4) EXISTING, PLANNED AND RECOMMENDED NOISE MANAGEMENT MEASURES FOR PREFFERRED OPTION

MEASURE ID	SOURCE	MEASURE DESCRIPTION	2018	2025
CE-3	FCC NAP; daa NMP	*Noise and Flight Track Monitoring System* – Enables the analysis of aircraft movements to assess whether they are operating within defined corridors. The primary objective of the Noise and Flight Track Monitoring System is to gather information on aircraft approach and departure routes and resultant noise levels at several key locations. This information is used by daa to respond to any complaints relating to aircraft noise. Continue to promote enhancements of the system to include near live-flight reporting and appropriate additional fixed and/or mobile noise monitoring terminals.	✓	✓
CE-4	FCC NAP; daa NMP	*Noise Complaint Management Systems* – Process and respond to all aviation-related noise complaints in a timely manner.	✓	✓

NOTES:
cNAO – candidate Noise Abatement Objective
daa NMP – daa Noise Management Plan
dB – Decibels
FCC NAP – Fingal County Council Noise Action Plan
HR – Hour
IAA ATC – Irish Aviation Authority air traffic control
ICAO – International Civil Aviation Organization
ILS – Instrument Landing System
KT –knots
L_{Aeq} – average sound level in A-weighted decibels
LAP - Local Area Plan

SOURCES: Fingal County Council, *Noise Action Plan for Dublin Airport – 2019 to 2023*, December 2018; daa, *Noise Management Plan*, May 2018; Irish Aviation Authority, *Dublin Airport Aeronautical Information Publication*, Section 2.21, November 5, 2020; Fingal County Council, *Dublin Airport 2020 Local Area Plan*, January 2020; Fingal Development Plan 2017-2023 Variation No. 1, December 9, 2019; An Bord Pleanála Reference Number PL06F.217429, 2007.

4. FORECAST INCLUDING ADDITIONAL MEASURES COMPARED TO PERMITED OPERATION SITUATION

The purpose of this assessment is to determine whether revoking two night-time operating restrictions in the *North Runway Planning Permission* conditions would require additional new mitigation measures to meet the cNAO and minimise potential significant adverse effects caused by increases in noise compared to the 2018 situation. The assessment results concluded that the Scenario 2 preferential runway use measure taken together with the proposed 55 dB L_{night} RSIGS, proposed ANQ quota count measure and proposed limitation on the use of Runway 10R-28L between 0000 and 0559 meets the cNAO and provides the lowest number of people expected to be exposed to increases in noise compared to the 2018 situation that have potential to cause significant adverse effects. This Preferred Option is considered the Forecast including Additional Measures scenario for consideration.[45] Because the Forecast including Additional Measures scenario and the Permitted Operations Situation scenario (with Condition 3[d] and 5 in place in 2025) both meet the cNAO, a cost-effectiveness analysis was conducted to compare the Forecast including Additional Measure scenario to the Permitted Operations Situation scenario to assess which of the two is more cost-effective. The following sections summarise the comparative results.

4.1 SUMMARY OF THE TWO SCENARIOS

The Permitted Operations Situation scenario includes existing and planned measures and the following planning conditions:

- North Runway Permission, Condition 3(a): the parallel runways (10R-28L and 10L-28R) shall be used in preference to the cross runway, Runway 16-34.[46]
- North Runway Permission, Condition 3(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.[47]
- North Runway Permission, Condition 3(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.[48]
- North Runway Permission, Condition 3(d): Runway 10L-28R shall not be used for take-off or landing between 2300 and 0700.[49]
- North Runway Permission, Condition 4: The crosswind runway (16-34) shall be restricted to essential occasional use on completion of the new runway in accordance with Objective DA03 of the Fingal County Development Plan, 2005-2011.[50] This is considered a planned measure listed in Table 3-1 as OR-1.

[45] Airport Noise Competent Authority defines "Forecast including Additional Measures" as a scenario that represents the noise conditions that would arise from any development proposals inclusive of specific or combinations of noise mitigation measures.

[46] Fingal County Council Ref: F04A/1755/E1, An Bord Pleanala Reference Number PL06F.217429.

[47] Fingal County Council Ref: F04A/1755/E1, An Bord Pleanala Reference Number PL06F.217429.

[48] Fingal County Council Ref: F04A/1755/E1, An Bord Pleanala Reference Number PL06F.217429.

[49] Fingal County Council Ref: F04A/1755/E1, An Bord Pleanala Reference Number PL06F.217429.

[50] Fingal County Council Ref: F04A/1755/E1, An Bord Pleanala Reference Number PL06F.217429.

- North Runway Permission, Condition 5: The average number of night-time aircraft movements at Dublin Airport shall not exceed 65 per night (between 2300 and 0700) when measured over the 92-day modelling period.[51]
- Terminal 2 Permission, Condition 3: The combined capacity of Terminal 2 as permitted together with Terminal 1 shall not exceed 32 mppa, unless otherwise authorised by a further grant of planning permission. This was related to the policies and objectives of the Dublin Airport Local Area Plan and capacity constraints (transportation) at the eastern campus.[52]

The Permitted Operations Situation would constrain the total number of movements Dublin Airport could serve, even though the runway and airfield will have the capacity to accommodate more movements.

The Forecast including Additional Measures scenario includes existing and planned measures and the following:

- North Runway Permission, Condition 3(a): the parallel runways (10R-28L and 10L-28R) shall be used in preference to the cross runway, Runway 16-34.
- North Runway Permission, Condition 4: The crosswind runway (16-34) shall be restricted to essential occasional use on completion of the new runway in accordance with Objective DA03 of the Fingal County Development Plan, 2005-2011.[53]
- Terminal 2 Permission, Condition 3: The combined capacity of Terminal 2 as permitted together with Terminal 1 shall not exceed 32 mppa, unless otherwise authorised by a further grant of planning permission.
- Scenario 2 Preferential Runway Use
  - For daytime hours and between 2300 to 2359 and 0600 to 0659 and 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,
  - For daytime hours and between 2300 to 2359 and 0600 to 0659 and 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, and
  - Runway 10L-28R shall not be used for take-off or landing between 0000 hours and 0559 hours except in cases of safety, maintenance considerations, exceptional air traffic conditions, adverse weather, technical faults in air traffic control systems or declared emergencies at other airports or where Runway 10R-28L length is required for a specific aircraft type[54]
- Proposed RSIGS to address night-time noise levels of at least 55 dB L_{night} in 2025
- Proposed QC system based on ANQ for the period 2330 to 0600 to be applied for each year from the opening of the North Runway to 2025[55]

This situation may begin to be constrained after annual passenger levels reach 32 mppa but will not be constrained due to movement or use restrictions related to preferential runway and time of day operation limits.

[51] Fingal County Council Ref: F04A/1755/E1, An Bord Pleanala Reference Number PL06F.217429.

[52] An Bord Pleanála Ref. PL 06F.220670/Fingal County Council Reg. Ref. F06A/1248.

[53] Fingal County Council Ref: F04A/1755/E1, An Bord Pleanala Reference Number PL06F.217429.

[54] Between 0000 and 0559, the airfield is limited to just the South Runway and there will be no use of the North Runway except for certain situations. This "no use" limit is considered a runway use operating restriction, but is not expected to limit movements or access due to historic low demand between 0000 and 0559 and the airfields available capacity under a single-runway condition to handle the expected demand.

[55] The Annual Night Quota between 2330 and 0600 is not expected to limit movements at passenger levels below 32 mppa.

This scenario also provides flexible use of Runways 10L-28R and 10R-28L during shoulder hours (2300 to 2359 and 0600 to 0659) if demand exceeds the capacity of a single runway or for increased efficiency and under specific exemptions.

4.2 COST-EFFECTIVENESS

Table 4-1 presents the cost-effectiveness results for the Forecast including Additional Measures and the Permitted Operations Situation scenarios based on the cost to implement divided by the change in population noise exposure levels compared to the 2018 situation. Refer to *Dublin Airport North Runway, Regulation 598/2014 (Aircraft Noise Regulation) Cost Effectiveness Analysis* report for details related to cost and effectiveness for both scenarios. The intent of this comparison is to assess which of the two scenarios is most cost-effective in meeting the cNAO. The HSD and HA populations are the units of measure to determine effectiveness.

The cost-effectiveness ratio for the Forecast including Additional Measures scenario is significantly lower compared to the Permitted Operations Situation for all metrics because of the lower cost. The cost associated with loss in economic growth described in Section 2.2.3 is substantially higher compared to implementing a preferential runway use measure and additional sound insulation grant scheme. Both scenarios meet the cNAO, but the Permitted Operations Situation is far more restrictive compared to the Forecast including Additional Measures scenario. According to the Aircraft Noise Regulation, operating restrictions should only be considered if needed to meet an objective and if not more restrictive than necessary to meet an objective. The Permitted Operations Situation by itself would meet the cNAO, but it is more restrictive and not as cost-effective compared to the Forecast including Additional Measures scenario.

TABLE 4-1 COST-EFFECTIVENESS OF FORECAST INCLUDING ADDITIONAL MEASURES VERSUS PERMITTED OPERATIONS SITUATION COMPARED TO 2018

	COST-EFFECTIVENESS RATIO TO REDUCE NUMBER OF PEOPLE HIGHLY SLEEP DISTURBED (HSD)		COST-EFFECTIVENESS RATIO TO REDUCE NUMBER OF PEOPLE HIGHLY ANNOYED (HA)	
SCENARIO	2025	CER RANKING	2025	CER RANKING
Forecast including Additional Measures	€113	1	€49	1
Permitted Operations Situation	€42,215	2	€21,162	2

NOTES:
CER Ranking based on lowest to highest absolute value ratio.
CER – Cost-Effectiveness Ratio
SOURCE: Ricondo & Associates, Inc., October 2020.