The assessment focusses on a comparison between the future permitted baseline (2022 constrained) and the proposed (unconstrained) operational scenario relating to the amendment to Condition 3(d) and the replacement of Condition 5. The future years assessed include 2022 and 2025.

The existing baseline (2018), is evaluated as this provides an empirical description of the effects when the airport was close to 32mppa. 2018 is also the existing baseline year examined in detail in the noise chapters.

- Existing baseline year (2018)
- Future years without the proposed Relevant Action (2022 and 2025 – 'permitted / constrained scenario'; and
- Future years with the proposed Relevant Action (2022 and 2025 – 'proposed / unconstrained scenario.'

The future year scenarios listed above are based on post-Covid-19 forecasts that take into account the ongoing pandemic and its effect on future anticipated growth at the Airport in line with UK Department for Transport vehicle emissions forecast. However, the detailed modelling of airside emissions used to inform this assessment (as described in Technical Appendix A10-A) is based on the following scenarios that assumed pre-Covid-19 forecast data, which does not take into account the ongoing pandemic:

- Future years without the proposed Relevant Action (2022, 2022 (32mppa) and 2027) – 'Permitted / Constrained'; and
- Future years with the proposed Relevant Action (2022, 2022 (32mppa) and 2027) – 'Proposed / Unconstrained.'

The implications of referring to air quality predictions based on pre-Covid-19 forecast data are discussed in more detail in section *10.13 Methodology for Determining Operational Effects*. In summary, the pre-Covid-19 forecasts assumed a greater number of Aircraft Traffic Movements (ATM) and are therefore considerably more conservative than the post-Covid-19 forecasts and as such, the contribution of airside sources to pollutant concentrations in both Permitted and Proposed scenarios will be less than those reported in this Chapter. For this assessment, it is assumed that the Proposed and Permitted 2022 and 2027 pre-Covid-19 scenarios modelled in the detailed assessment (Technical Appendix A10-A) conservatively represent (i.e to consider the "worst case" or greater levels of impact) the 2022 and 2025 post-Covid-19 scenarios respectively. Based on professional judgment, this is considered to be an acceptable, proportionate and robust means by which to capture and identify any potential significant air quality effects.

10.2 Legislation and Planning Policy Context

10.2.1 National Legislation

10.2.1.1 Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011)

The Air Quality Standard Regulations 2011 implement the European Union Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe (CAFE) and designate the EPA as the competent authority responsible for assessing ambient air quality in the territory of the State. The standards also establish Limit Values and alert thresholds for concentrations of certain pollutants in ambient air, to prevent or reduce harmful effects on human health and the environment.

The Air Quality Limit Values as set out in the regulations and considered within this assessment are provided in Table 10-1.

Table 10-1: Air Quality Limit Values

Pollutant	Averaging Period	Concentration ($\mu g/m^3$)	Permitted Exceedances
NO_2	Annual mean	40	None
	1-hour mean	200	not to be exceeded more than 18 times a year
PM_{10}	Annual mean	40	None

	24-hour mean	50	not to be exceeded more than 35 times a year
$PM_{2.5}$	Annual Mean	25	None

10.2.1.2 Air Pollution Act 1987 (Number 6 of 1987)

The Air Pollution Act 1987 provides local authorities with the primary responsibility for monitoring air quality, including the nature, extent and effects of emissions within their administrative area.

Local authorities are also given powers under the Act to take measures to prevent or limit air pollution in their administrative area. Owners of certain industrial activities must have an air pollution licence from either the local authority or the EPA, to run industries that are responsible for emissions.

10.2.1.3 Environmental Protection Agency Act 1992 (Number 7 of 1992)

The Environmental Protection Agency Act 1992 established the remit of the environmental regulator in Ireland to make further and better provision for the protection of the environment and the control of pollution.

Amongst the many duties of the EPA is the monitoring of local air quality across the country, including multiple locations in the Dublin region, and the regulation of licenced activities with emissions to air.

10.2.1.4 Protection of the Environment Act 2003

The Protection of the Environment Act 2003 was implemented to account for the European Union Directive 96/61/EC, of 24 September 1996, concerning Integrated Pollution Prevention and Control; this Amended the Environmental Protection Agency Act 1992.

10.2.2 National Planning Policy

10.2.2.1 National Aviation Policy (2015)

The National Aviation Policy (ICAO, 2016) sets out the Government's goals and commitments to the aviation industry in Ireland. Whereas the focus of this Policy in on the reduction of Greenhouse Gases (GHGs), the following points are of relevance to this assessment:

"Ireland is committed to working with its EU and international partners to mitigate the impacts of aviation on the environment and facilitate the sustainable growth of the sector

...

2.3.1 Ireland will work with European partners to achieve the development of global international standards for market based measures on aircraft emissions.

2.3.2 Ireland will develop its aviation emissions reporting capability in support of ICAO's evolving environmental policies.

...

2.3.4 Ireland will encourage research and development in Ireland of clean engine technologies and sustainable fuels."

10.2.2.2 Project Ireland 2040

Project Ireland 2040 is the Government's long-term overarching strategy for future development and infrastructure in Ireland. It consists of several documents, including the National Planning Framework (DHPLG, 2018), which is the Government's high-level strategic Plan for shaping the future growth and development of Ireland up to 2040.

The National Planning Framework includes the following overarching aim that is relevant to this assessment:

"Creating a Clean Environment for a Healthy Society:

...

Promoting Cleaner Air: Addressing air quality problems in urban and rural areas through better planning and design."

The National Planning Framework includes National Policy Objective 64, which stresses the importance of improving ambient air quality:

"National Policy Objective 64: Improve air quality and help prevent people being exposed to unacceptable levels of pollution in our urban and rural areas through integrated land use and spatial planning that supports public transport, walking and cycling as more favourable modes of transport to the private car, the promotion of energy efficient buildings and homes, heating systems with zero local emissions, green infrastructure planning and innovative design solutions."

Project Ireland 2040 also includes the Government's National Development Plan (DHPLG, 2018). This document is focused on Ireland's long-term economic, environmental and social progress up to 2027, and references improvements in air quality as an additional benefit to improving energy efficiency for the primary purpose of reducing carbon emissions.

10.2.3 Local Planning Policy

10.2.3.1 Fingal County Council Development Plan 2017-2023

The Fingal Development Plan 2017-2023 ("Development Plan) (FCC, 2017) sets out Fingal County Council's (FCC) proposed policies and objectives for the development of the County over the Plan period of 2017 to 2023. The Development Plan seeks to develop and improve, in a sustainable manner, the social, economic, environmental and cultural assets of the County.

The Development Plan includes multiple objectives that target the improvement of ambient air quality, including:

> *"**Objective AQ01** - Implement the provisions of EU and National legislation on air, light and noise and other relevant legislative requirements, as appropriate and in conjunction with all relevant stakeholders."*

The Development Plan states that FCC has adopted the Dublin Regional Air Quality Management Plan (DRAQMP):

> *"**Objective AQ02** - Implement the recommendations of the Dublin Regional Air Quality Management Plan (or any subsequent plan) and any other relevant policy documents and legislation in order to preserve good air quality where it exists or aim to improve air quality where it is unsatisfactory."*

With relation to the DRAQMP, the Development Plan states that the long-term monitoring of air quality at Dublin Airport and nearby major roads should continue and that as the Airport expands, the objectives of the Plan and its monitoring network should be revised to ensure appropriate coverage.

Some of the Development Plan objectives also relate specifically to Dublin Airport. That of relevance to air quality includes:

> *"**Objective DA18** - Ensure that every development proposal in the environs of the Airport takes account of the current and predicted changes in air quality, greenhouse emissions and local environmental conditions."*

10.2.3.2 Dublin Airport Local Area Plan 2020

The Dublin Airport Local Area Plan (LAP) (FCC, 2020) sets out how the Airport growth can be achieved sustainably.

The LAP includes the following objectives relating to air quality, not including those already listed within the Fingal Development Plan:

> *"**Objective AQ04** - Take account of the global and local impacts of aviation as well as the likelihood of international action to limit greenhouse gas emissions from aviation through action at the International Civil Aviation Organisation (ICAO)as mandated in the Kyoto Protocol when evaluating any proposals to significantly increase the use of Dublin Airport."*
>
> *"**Objective AQ05** - Undertake a review of existing air quality monitoring (and associated appropriate remedial action in the case of breaches) within and surrounding the Airport (including changes in Particulate Matter (PM) at relevant locations). Where relevant, such a review should identify additional monitoring proposals, remedial actions and implementation systems – such needs shall be provided for by Fingal County Council and/or daa."*

The Plan also acknowledges that the Airport impacts on air quality from the following activities:

- Emissions associated with ongoing operations of the Airport, such as aircraft and support services, and surrounding areas as a result of traffic accessing the Airport.

10.2.3.3 Dublin Regional Air Quality Management Plan 2009-2012

The DRAQMP (DCC, 2009) is referred to in both the Fingal Development Plan and the Dublin Airport Local Area Plan. The DRAQMP acknowledges that NO_2 and PM_{10} are the pollutants of most concern in the region.

It lists the following strategies local authorities in the region should consider to improve local air quality:

- Improve coordination of efforts and build on the good work to date;
- Mainstream air quality management into all major Policy areas;
- Strengthen evidence-based decision making by improving how information is shared on air quality;
- Lead by example with measures related to local authority activities that will reduce emissions;
- Identify and prioritise tackling main potential threats to air quality; and
- Provide clear time- bound criteria for the achievement of objectives.

Following the publication of the Air Quality Management Plan 2009-2012, a subsequent Air Quality Management Plan was published focusing on improving levels of NO_2 in the Dublin region (DCC, 2009). This document was prepared following a reported exceedance of annual mean air quality standard for NO_2 within the Dublin region in 2009.

The document analyses and considers the reason for the exceedance and responsible sources, as well as summarising existing (at the time of publication) national, regional and local Policy for improving air quality.

It goes on to suggest measures that could be implemented in the future to improve air quality conditions, nationally, regionally and locally. These include improved emissions technology within the power sector, the publication of regional development plans with greater emphasis on improving air quality and the promotion and implementation of sustainable transport.

10.2.4 Other Relevant Policy, Standards and Guidance

10.2.4.1 Airport Air Quality Manual 2016

Published by the International Civil Aviation Organization (ICAO), the Airport Air Quality Manual (ICAO, 2011) provides internationally recognised guidance on how to compile emissions inventories associated with Airport sources and how to use dispersion modelling to estimate the contribution of these emissions to local ambient concentrations.

This guidance has been used both for the compilation of the emissions inventory and to inform dispersion modelling method, as set out in Technical Appendix A10-A.

10.2.4.2 Local Air Quality Management Technical Guidance 2016

The UK Department for Environment, Food and Rural Affairs published their Local Air Quality Management Technical Guidance (DCC, 2009) to assist local authorities in the UK with their responsibilities to review and assess local air quality in their administrative areas. The technical guidance provides methods and tools that can be applied for air quality assessment, including an approach to dispersion model verification and the conversion of nitrogen oxides (NO_X) to NO_2 for road traffic sources.

10.2.4.3 Land-Use Planning & Development Control: Planning For Air Quality 2017

The Institute of Air Quality Management and Environmental Protection UK provide guidance for the consideration of air quality within the land-use planning and development control process (EPUK, 2017). The guidance sets out a means of describing air quality impacts based on the relationship between the magnitude of change and total pollutant concentration experienced, relative to the air quality standards (see Section 11.2). Therefore, a smaller magnitude of change could potentially have a greater impact, where total concentrations are close to or above an air quality standard, when compared to a larger magnitude of change, where total concentrations are below and not at risk of exceeding the standard.

10.3 Assessment Methodology

This section of this EIAR Chapter presents the following:

- Information sources that have been consulted throughout the preparation of this Chapter;
- Details of consultation undertaken concerning air quality;
- The methodology for the assessment of air quality effects, including the criteria for the determination of the sensitivity of receptors and magnitudes of change from the existing 'baseline' condition;
- An explanation as to how the identification and assessment of potential air quality effects has been reached; and
- The significance criteria and terminology for the assessment of air quality residual effects.

The following sources of information that define the proposed Relevant Action have been reviewed and form the basis of the assessment of likely significant effects on air quality:

- Detailed plans and elevations;
- Current and forecast data for the following sources:
  - Aircraft emissions (main engines operating within the Landing and Take-off (LTO) Cycle and the use of aircraft Auxiliary Power Units (APUs);
  - Aircraft handling emissions (Ground Support Equipment (GSE) including airside vehicles and Mobile Ground Power Units);
  - Infrastructure and stationary sources (such as energy plant); and
  - Vehicle traffic sources (landside).
- Local air quality monitoring data sourced from daa and the EPA; and
- Hourly sequential meteorological data sourced from Met Eireann.

10.3.1 Methodology for Determining Baseline Conditions and Sensitive Receptors

The study area (Figure 10-1) has been defined based on ICAO's Airport Air Quality Manual taking into account a geographical area where there is a potential for a change in air quality with the proposed operations and the extent of the road transport network considered. The contribution of Airport sources beyond 1km is negligible, based on professional experience.

Baseline (2018) air quality conditions have been identified and reviewed for both total and background concentrations for all of the pollutants of interest. Further information is provided in Section 10.5.

Sensitive receptors have been identified according to National Roads Authority Guidance (NRA, 2011). Receptors are classified as locations where members of the public are likely to be regularly present. These include residential housing, schools, hospitals, places of worship, sports centres and shopping areas. In selecting relevant receptors for assessment, consideration has been given to locations that may be affected by the operation of the North Runway and wider runway system.

Further details concerning sensitive receptors can be found in Section 10.5.

10.3.2 Methodology for Determining Construction Effects

As the proposed Relevant Action will result in no changes to the design or construction methodology of the North Runway. On that basis, the assessment of construction phase impacts on air quality has been scoped out of the EIA.

10.3.3 Methodology for Determining Operational Effects

The contribution of emissions associated with the existing Baseline (2018), Permitted / Constrained and Proposed / Unconstrained scenarios, and total pollutant concentrations at sensitive receptors, have been predicted using the detailed methodology described in Technical Appendix A10-A.

This has included the contribution of emissions from modelled airside sources and future baseline traffic flows. As first stated in section *10.1 Scope of Assessment*, the detailed assessment has considered more conservative aircraft forecasts than currently projected in both Permitted and Proposed scenarios, as summarised in Table 10-2. This is because at an earlier stage of the project, detailed modelling was undertaken using pre-Covid forecasts for assessment years 2022 and 2027, which contain higher ATM) than are now forecast for this proposed Relevant Action application. Based on professional judgement, it has been decided to continue to use modelling outputs from the modelling undertaken using the pre-Covid forecasts for the Air Quality assessment. This is considered an acceptable approach, as it represents a very conservative worst-case scenario. The forecast data for the existing Baseline scenario remains as modelled.

Table 10-2 Comparison of modelled Pre-Covid-19 Forecasts (A) and current Post-Covid-19 Forecasts (B)

Scenario	Year	Pre-Covid-19 Forecasts (ATM (000s))	Post-Covid-19 Forecasts (ATM (000s))	% Difference
Permitted	2022	225	223	-1%
	2025/27[1]	220[2]	233	+6%
Proposed	2022	255	229	-10%
	2025/27[1]	273[3]	241	-12%
Change (Proposed – Permitted)	2022	+30	+6	-80%
	2025/27[1]	+53	+8	-85%

Notes:

[1]Pre-Covid-19 forecast scenario data projected to 2027; Post-Covid-19 forecast scenario data projected to 2025.

[2]Permitted Pre-Covid-19 forecast data when projected to 2025 was 222,000 ATM

[3]Proposed Pre-Covid-19 forecast data when projected to 2025 was 264,000 ATM.

Table 10-2 demonstrates the conservative nature of the detailed assessment of airside sources, with pre-Covid-19 forecasts (as ATM) being higher than the respective post-Covid-19 forecasts now anticipated, for the 2022 Permitted and 2022 and 2025 Proposed Scenarios. It also shows that the change from Permitted to Proposed scenarios quantified in the detailed assessment using the pre-Covid-19 forecasts is more conservative than the same change based on current post-Covid-19 forecasts. The implications of the reduced emissions cannot be directly applied to modelled predictions of total pollutants reported. However, the percentage change in forecast data, and the difference between Permitted and Proposed scenarios, does provide clear indication that the contribution of airside sources to those pollutant concentrations and reported impacts are now significantly over-estimated. The 2022 and 2027 Permitted and Proposed scenario's total pollutant concentrations, and the change in concentration between 2022 and 2027 Permitted and Proposed scenarios, as quantified in the detailed assessment, are therefore considered to conservatively represent conditions in 2022 and 2025 for purposes of this assessment.

The difference between the 2027 Permitted and Proposed scenarios included in the detailed assessment and the 2025 Permitted and Proposed scenarios for which approvals are being sought, beyond the difference in forecast data described in the previous paragraph, is the change in future baseline traffic flow emissions. For 2027, the modelled contribution of future baseline road traffic emissions is based on an assumed level of year on year traffic flow growth on the local road network from the 2018 baseline to 2027. The 2025 scenarios now considered will see two years less growth than the 2027 scenarios included in the detailed assessment. However, whilst that would see a potential reduction in traffic flows, it would also see a potential increase in emission rates per vehicle. This is because the 2027 scenarios considered in the detailed assessment include two additional years of vehicle emissions technology improvements and evolution of the national vehicle fleet. In light of the above, with any improvement as result of lower flows offset by increased emission rates, it is considered that the future Baseline road traffic emissions contribution to total pollutant concentrations, as reported in the detailed assessment for 2027, is representative of future Baseline contributions in 2025.

Operational effects have been determined based on the descriptors included within the guidance issued by Environmental Protection UK and the Institute of Air Quality Management (EPUK, 2017). The impact descriptors express the magnitude of incremental change as a proportion of the relevant assessment level and then examine this change in the context of the new, total concentration, and its relationship to the assessment criterion. More information can be found in Paragraph "Significance Criteria" that follows.

10.3.4 Significance Criteria

The assessment refers to the 2017 guidance published by the EPA on assessing the significance of effects (EPA, 2017). It also takes into account the orientation of effect (positive, negative or neutral), the duration of effect, the extent and context of the effect, the significance of effect, the probability of effect, duration and frequency.

The assessment refers to guidance issued by Environmental Protection UK and the Institute of Air Quality Management (EPUK, 2017), which provides a means to describe the impact of the Proposed Scheme at individual receptors based on dispersion model outputs. The Environmental Protection UK and the Institute of Air Quality Management guidance uses the term "impact" to describe a change in pollutant concentration at a specific location, and the term "effect" to describe an environmental response resulting from the impact.

Receptors associated with human health impacts are selected based on the likely exposure of the public to the pollutants of concern for periods that are representative of the air quality standards, such as residential properties, schools and medical facilities with over-night accommodation. Land uses are, therefore either sensitive or not sensitive to air quality impacts. Where sensitive receptors are identified, all are considered to be as highly sensitive as each other.

The Environmental Protection UK and the Institute of Air Quality Management guidance states that an air quality impact can be expressed as the magnitude of change in pollutant concentration as a proportion of the relevant assessment level (for example the relevant air quality standards), and then to examine this change in the context of the total pollutant concentration with the proposed Relevant Action in place. This is summarised in Table 10-3.

Table 10-3: Air Quality Impact Descriptors At Individual Receptors

Long-term average concentration	% change in concentration relative to air quality assessment level				
	<1	1 – 2	2 – 5	6 – 10	>10
75% or less of Limit Value	Negligible	Negligible	Negligible	Slight	Moderate
76% - 94% of Limit Value	Negligible	Negligible	Slight	Moderate	Moderate
95% - 102% of Limit Value	Negligible	Slight	Moderate	Moderate	Substantial
103% - 109% of Limit Value	Negligible	Moderate	Moderate	Substantial	Substantial
110% or more of Limit Value	Negligible	Moderate	Substantial	Substantial	Substantial

Source: EPUK/IAQM 'Land-Use Planning & Development Control: Planning for Air Quality,2017'

The Environmental Protection UK and the Institute of Air Quality Management guidance includes seven explanatory notes to accompany the terminology for the descriptors listed in Table 10-3. It is noted that the descriptors are for individual receptors only and that overall significance is determined using professional judgement. Additionally, it is also noted that it is unwise to ascribe too much accuracy to incremental changes or background concentrations; this is especially important when total concentrations are close to the Limit Value. For a given year in the future, it is impossible to define the new total concentration without recognising the inherent uncertainty, which is why there is a category that has a range around the Limit Value for annual mean NO_2 (and annual mean PM_{10}), rather than being precisely equal to it.

A change in predicted annual mean concentrations of NO_2 or PM_{10} of less than 0.5% (0.2 $\mu g/m^3$) is considered to be imperceptible. A change (impact) that is imperceptible, given reasonable bounds of variation, would not be capable of having a direct effect on local air quality that could be considered to be significant. Likewise, a change in predicted annual mean concentrations of $PM_{2.5}$ of less than 0.5% (0.12 $\mu g/m^3$) is also considered to be imperceptible.

Additionally, the guidance also includes the potential for slight air quality impacts as a result of changes in pollutant concentrations between 2% and 5% of relevant air quality standards. For annual average NO_2 and PM_{10} concentrations, this relates to changes in concentrations ranging from 0.6 – 2.1 $\mu g/m^3$. In practice, changes in concentration of this magnitude at the lower end of this band are likely to be very difficult to distinguish through any post-operational monitoring regime, due to the number of sources of NO_2 in an urban environment and the interannual effects of varying meteorological conditions. In the overall evaluation of significance, the potential for significant air quality impacts within this band is, therefore, considered in this context.

Changes in concentration of more than 5% (moderate and substantial, the two highest bands) are considered to be of a magnitude which is far more likely to be discernible and as such carry additional weight within the overall evaluation of significance for air quality.

It should be noted that the impact descriptors in Table 10-3, are intended for application at individual modelled sensitive receptors. While there may be a 'slight', 'moderate' or 'substantial' impact at one or more receptors, the overall effect may not necessarily be judged as being significant in some circumstances. The overall significance of effects is determined using professional judgement, taking this into account and the EPA Advice Note criteria described above.

10.4 Assumptions, Limitations and Uncertainty

As stated in section *10.1 Scope of Assessment* and section *10.3 Methodology for Determining Operational Effects*, the quantification of Permitted and Proposed total pollutant concentrations and associated impacts for scenarios in 2022 and 2025 (post-Covid-19 forecasts) is based on earlier modelling that considered pre-Covid-19 forecasts for 2022 and 2027. Predictions of total pollutant concentrations and impacts using the pre-Covid-19 forecasts for 2022 and 2027 are considered to be a very conservative representation of the post-Covid-19 conditions in 2022 and 2025 respectively up to and beyond the likely worst case. This is professionally considered to represent a proportionate level of assessment for the current proposals.

All model assumptions used during the air quality assessment are presented in Technical Appendix A10-A, where the inputs of the model as well as their limitations are described in detail.

10.5 Baseline Conditions

10.5.1 Existing Baseline

Existing monitoring data made available by daa and the EPA allow for a general discussion of baseline air quality in the vicinity of the site.

10.5.1.1 Dublin Airport Authority Pollutant Monitoring

Over the past few years, daa has undertaken the monitoring of a range of pollutants at a continuous monitoring station located on the grounds of Dublin Airport. The concentrations measured for NO_2 and PM_{10} are reported quarterly by daa. The annual data are summarised in Table 10-4. This data demonstrates that annual mean NO_2 and PM_{10} concentrations monitored at Dublin Airport are consistently below relevant air quality standard values, typically representing around 50 - 60% of those values. It should be noted that activity around the location of the continuous analyser location increased significantly in recent years with a construction compound being located close to it.

Table 10-4: Continuous NO_2 Measurement Data – daa Dublin Airport

Pollutant and Averaging Period	Concentration / Number of Exceedances of Short-Term Air Quality Limit								
	2011	2012	2013	2014	2015	2016	2017	2018	2019
NO_2 - µg/m³ (Annual Mean) Limit Value **40 µg/m³**	16	19	19	22	22	23	20	28	28
PM_{10} - µg/m³ (Annual Mean) Limit Value **40 µg/m³**	18	20	23	21	20	23	21	20	18
PM_{10} - Days (Daily Mean) Limit Value **35 Days**	0	2	3	4	6	8	4	0	5

Notes: Concentrations rounded to whole numbers

Source: Dublin Airport Air Quality Monitoring – Annual Report 2019

In addition to the continuous monitoring data gathered within the Dublin Airport grounds, daa has also undertaken the measurements of NO_2, and benzene (C_6H_6) using passive sampling by diffusion tubes at several offsite locations in the vicinity of Dublin Airport. The concentrations measured for NO_2, and C_6H_6 are also reported quarterly, and the annual data are summarised in Table 10-5 to Table 10-7.

The data presented in these Tables demonstrate that the Air Quality Limit Values for the pollutants monitored are not being exceeded. Annual mean concentrations of NO_2 are notably higher at locations closest to roads where the primary source of air pollution is the road network itself (A5 to A7). It is also noted that NO_2 concentrations have been steadily increasing over the last eight years. Locations A5 and A6 are site boundary locations, and A11 represent the Airport bus station and do not represent relevant air quality sensitive exposure. They either comprise part of the Airport area and thus are not representative of sensitive receptor locations, or are sited explicitly to support local initiatives, such as monitoring the effects of buses switching engines on/off when idling. Some of the locations also changed position over the ten-year monitoring period.

Table 10-5: Passive NO_2 Measurement Data – daa Dublin Airport

Location	Concentration (µg/m³)								
	2011	2012	2013	2014	2015	2016	2017	2018	2019
A1 - Forrest Little Golf Club	10	12	18	18	18	18	18	20	18
A2 - Kilreesk Lane, St. Margaret's	8	8	12	12	13	12	12	16	16
A3 - Ridgewood Estate West, Swords	9	9	17	n/a	n/a	20	17	17	16
A4 - St. Margaret's School and Parish House	10	11	16	15	16	16	16	19	17
A5 - Fire Station, Huntstown, Dublin Airport	11	13	18	19	20	22	24	29	25
A6 - Southern Boundary Fence, Dublin Airport	16	23	29	26	28	30	29	32	29
A7 - Western Boundary Fence, Dublin Airport	20	17	24	26	25	27	25	30	30
A8 - St. Nicholas of Myra School, Malahide Road	10	10	14	14	16	15	19	19	19
A9 - Naomh Mearnóg GAA Club Portmarnock	7	9	15	14	14	13	15	15	15
A10 - Oscar Papa Site, Portmarnock	9	10	15	14	14	15	15	16	17
A11 - Airport Bus Depot	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**43**
A12 - Portmellick House, Dunbro Lane	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	23
Air Quality Standard						**40**			

Notes: Concentrations rounded to whole numbers

Source: Dublin Airport Air Quality Monitoring – Annual Report 2019

Table 10-6: Passive Benzene Measurement Data – daa Dublin Airport

Location	Concentration (µg/m³)								
	2011	2012	2013	2014	2015	2016	2017	2018	2019
A1 - Forrest Little Golf Club	0.5	0.2	0.6	n/a	n/a	0.8	0.5	0.6	0.5
A2 - Kilreesk Lane, St. Margaret's	0.5	0.3	0.5	n/a	n/a	0.4	0.3	0.4	0.4
A3 - Ridgewood Estate West, Swords	0.3	0.2	0.6	n/a	n/a	0.6	0.4	0.5	0.4
A4 - St. Margaret's School and Parish House	0.4	0.3	0.5	n/a	n/a	0.4	0.4	0.5	0.4
A5 - Fire Station, Huntstown, Dublin Airport	0.4	0.3	0.5	n/a	n/a	0.8	0.4	0.5	0.6
A6 - Southern Boundary Fence, Dublin Airport	0.4	0.3	0.5	n/a	n/a	0.5	0.6	0.4	0.4
A7 - Western Boundary Fence, Dublin Airport	0.6	0.2	0.5	n/a	n/a	0.5	0.4	0.3	0.3
A8 - St. Nicholas of Myra School, Malahide Road	0.6	0.2	0.5	n/a	n/a	0.5	0.5	0.5	0.5
A9 - Naomh Mearnóg GAA Club Portmarnock	0.4	0.6	0.5	n/a	n/a	0.5	0.5	0.4	0.5

Location	Concentration (µg/m³)								
	2011	2012	2013	2014	2015	2016	2017	2018	2019
A10 - Oscar Papa Site, Portmarnock	0.8	0.4	0.5	n/a	n/a	0.6	0.5	0.4	0.4
A11 - Airport Bus Depot	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.6
A12 - Portmellick House, Dunbro Lane	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.3
Air Quality Standard						**5**			

Source: Dublin Airport Authority, Dublin Airport Air Quality Monitoring – Annual Report 2019

10.5.1.2 EPA Pollutant Monitoring

The EPA measure annual mean concentrations of numerous pollutants in the Dublin region, including annual mean concentrations of NO_2, PM_{10} and $PM_{2.5}$. None of these monitoring locations are located close to Dublin Airport. The monitoring location in Swords is the closest, which is over 2 km to the north of the Airport The data gathered over recent years are summarised in Table 10-7 to Table 10-9. Location-specific data available for the most recent years demonstrates further compliance with the air quality standard values for these pollutants at the majority of areas considered by the EPA, with the exception of recent NO_2 monitoring on Pearse Street and St. Johns Road. Neither of these monitoring sites are in close proximity to Dublin Airport. The range in concentrations between measurement sites is likely due to their location and proximity to sources of existing emissions to air, such as busy roads and/or industrial stacks.

Table 10-7: Annual Mean NO_2 Monitoring Results (µg/m³)

Location	2012	2013	2014	2015	2016	2017	2018	2019
Ballyfermot	-	16	16	16	17	17	17	20
Blanchardstown	-	-	-	-	-	-	25	31
Coleraine Street	-	-	-	-	28	26	-	-
Davitt Road	-	-	-	-	-	-	26*	24
Dun Laoghaire	18	16	15	16	19	17	19	15
Pearse St	-	-	-	-	-	-	-	49
Rathmines	21	19	17	18	20	17	20	22
Ringsend	-	-	-	-	-	22	27	24
St. Anne's Park	-	12	14	14	-	-	-	-
St. Johns Road	-	-	-	-	-	-	44*	43
Swords	15	15	14	13	16	14	16	15
Winetavern St	29	31	31	31	37	27	29	28
Air Quality Standard						**40**		

Notes: Concentrations rounded to whole numbers

* Monitoring undertaken for less than a year and may not comparable to the annual mean air quality standard.

Source: EPA, Air Quality in Ireland 2019

Table 10-8: Annual Mean PM_{10} Monitoring Results (µg/m³)

Location	2012	2013	2014	2015	2016	2017	2018	2019
Ballyfermot	-	12	11	12	11	12	16	14
Blanchardstown	-	-	-	-	18	15	17	19
Davitt Road	-	-	-	-	-	-	14*	15

Location	2012	2013	2014	2015	2016	2017	2018	2019
Dun Laoghaire	-	17	14	13	13	12	13	12
Finglas	-	15	-	-	-	-	11*	13
Marino	-	-	-	-	-	-	12*	14
Phoenix Park	11	14	12	12	11	9	11	11
Rathmines	14	17	14	15	15	13	15	15
Ringsend	-	-	-	-	-	13	20	19
St. Anne's Park	-	19	17	15	-	-	11*	12
St. Johns Road	-	-	-	-	-	-	14*	14
Tallaght	-	-	-	-	14	12	15	12
Winetavern St	13	14	14	14	14	13	14	15
Air Quality Standard					**40**			

Notes: Concentrations rounded to whole numbers

* Monitoring undertaken for less than a year and may not comparable to the annual mean air quality standard.

Source: EPA, Air Quality in Ireland 2019

Table 10-9: Annual Mean $PM_{2.5}$ Monitoring Results (µg/m^3)

Location	2012	2013	2014	2015	2016	2017	2018	2019
Ballyfermot	-	-	-	-	-	-	7*	10
Coleraine Street	-	-	-	-	9	8	-	10
Davitt Road							8*	11
Finglas	-	-	7	8	9	7	8	9
Marino	8	9	8	8	7	7	6	9
Phoenix Park	-	-	-	-	-	-	6	8
Rathmines	11	11	9	10	10	9	9	8
Ringsend							8*	10
St. Anne's Park	-	-	-	-	-	-	7*	8
St. Johns Road	-	-	-	-	-	-	9*	9
Air Quality Standard					**25**			

Notes: Concentrations rounded to whole numbers

* Monitoring undertaken for less than a year and may not comparable to the annual mean air quality standard.

Source: EPA, Air Quality in Ireland 2019

10.5.1.3 Background Concentrations

Model outputs are combined with background concentrations to predict total pollutant concentrations at modelled receptors. Background concentrations are those from many sources which individually may not be significant, but collectively, over a large area, need to be considered.

Background pollutant concentrations have been defined from the latest available local monitoring data. Even though the national network consists of a variety of background monitoring locations for NO_2 and PM_{10}, there are only limited data to describe $PM_{2.5}$ background concentrations. The approach taken to estimate $PM_{2.5}$ concentrations was to use the UK Government's background pollutant concentrations maps (DEFRA, 2019) to calculate the average ratio between PM_{10} and $PM_{2.5}$ concentrations across the whole of Northern Ireland (mapped background data are not available for the Republic of Ireland) and apply this ratio to the measured PM_{10} background concentrations. The monitoring location considered to be representative of ambient background concentrations at Dublin Airport is Swords for NO_2 and Phoenix Park for PM_{10}. The baseline and future year background pollutant levels can be seen below in Table 10-10.

Table 10-10: Background Concentrations (µg/m³)

Pollutant	Year			
	2018	2022	2025	2027
NO_2	16.0	13.7	12.7	12.0
PM_{10}	11.0	10.5	10.3	10.2
$PM_{2.5}$	6.8	6.4	6.2	6.1

Sources: EPA, Air Quality in Ireland 2018

10.5.1.4 Receptors

Receptors considered in the detailed modelling study include a selection of residential properties and other sensitive locations such as schools and community facilities. A total of 52 existing receptors were modelled that may be affected by the operation of the permitted North Runaway, details of which can be found in Table 10-11 and Figure 10-1.

In some instances, a single receptor location has been selected to represent a group of residential properties, as the predicted concentrations would tend to be similar within the cluster of properties.

Table 10-11: Modelled Receptor Information

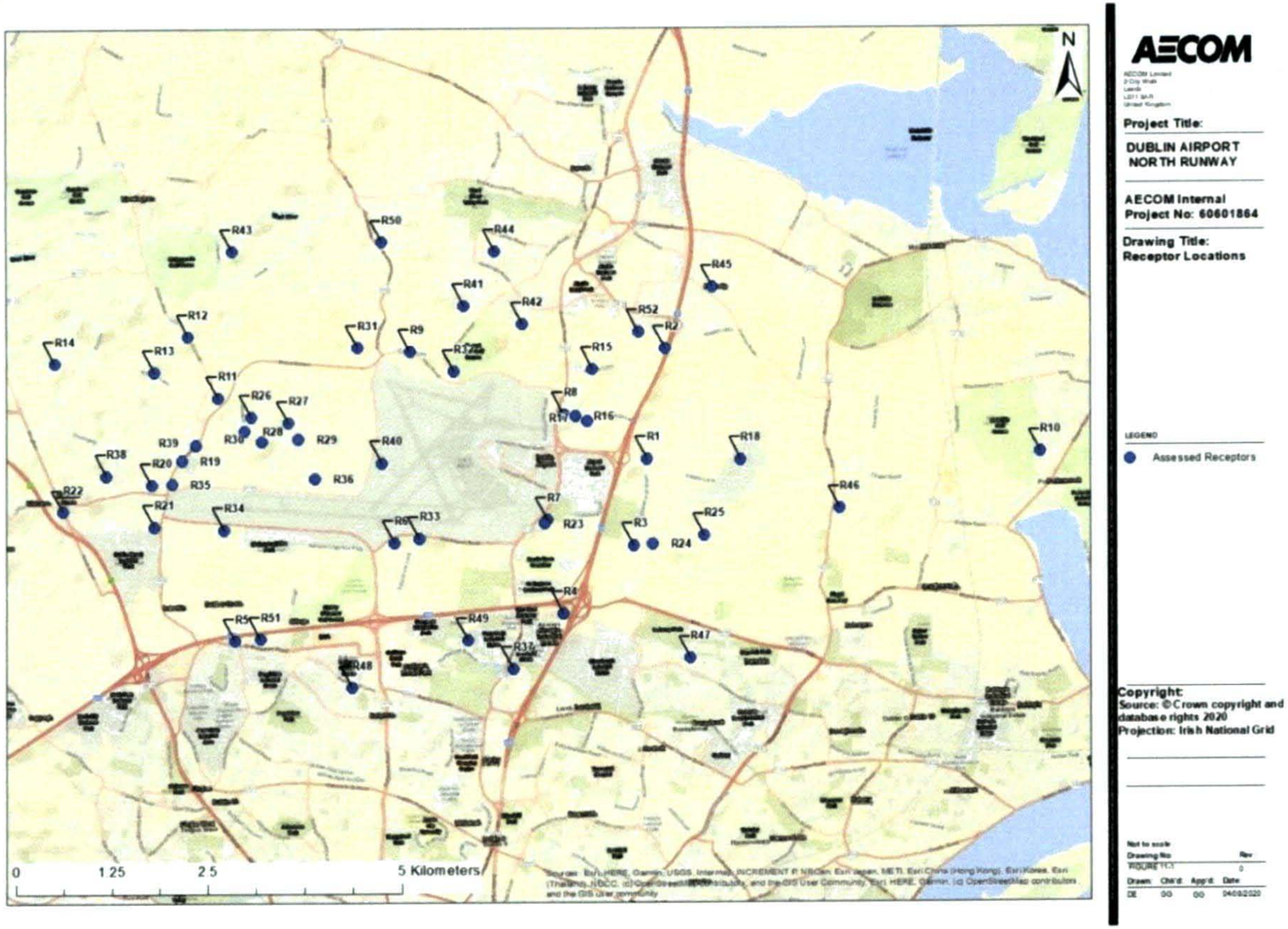
	Coordinate X	Coordinate Y	Height Z	Receptor Type
R1	318798	243360	1.5	Residential
R2	319033	244780	1.5	Residential
R3	318630	242250	1.5	Residential
R4	317726	241372	1.5	Residential
R5	313514	241030	1.5	Residential
R6	315562	242290	1.5	Residential
R7	317519	242579	1.5	Residential
R8	317729	243939	4.5	Public House
R9	315763	244749	1.5	Residential
R10	323880	243429	1.5	Residential
R11	313298	244155	1.5	Residential
R12	312909	244952	1.5	Residential
R13	312469	244492	1.5	Residential
R14	311160	244610	1.5	Residential
R15	318102	244515	1.5	Residential
R16	317888	243916	1.5	Residential
R17	318032	243850	1.5	Residential
R18	320013	243349	1.5	Residential
R19	312827	243360	1.5	Residential
R20	312430	243045	1.5	Residential
R21	312467	242503	1.5	Residential
R22	311268	242704	1.5	Residential
R23	317492	242531	1.5	Residential

	Coordinate X	Coordinate Y	Height Z	Receptor Type
R24	318874	242268	1.5	Residential
R25	319541	242373	1.5	Residential
R26	313730	243918	1.5	Residential
R27	314205	243834	1.5	Residential
R28	313642	243728	1.5	Residential
R29	314338	243623	1.5	Residential
R30	313862	243591	1.5	Residential
R31	315095	244802	1.5	Residential
R32	316326	244488	1.5	Residential
R33	315883	242339	1.5	Residential
R34	313373	242465	1.5	Residential
R35	312699	243059	1.5	Residential
R36	314546	243128	1.5	Residential
R37	317082	240657	1.5	Residential
R38	311841	243162	1.5	Residential
R39	313017	243550	1.5	School
R40	315404	243316	1.5	Residential
R41	316456	245336	1.5	Residential
R42	317203	245096	1.5	Residential
R43	313483	246051	1.5	School
R44	316850	246041	1.5	School
R45	319651	245565	1.5	School
R46	321294	242722	1.5	School
R47	319361	240790	1.5	School
R48	315022	240425	1.5	School
R49	316502	241030	1.5	Residential
R50	315409	246163	1.5	Residential
R51	313841	241050	1.5	Residential
R52	318690	244991	1.5	Residential

Source: AQC (2020) - Dublin Airport North Runway: Relevant Action Application - Technical Report

A visual representation of the relative receptor location around the area of the Dublin Airport is provided below in Figure 10-1.

Figure 10-1: Location Of Modelled Receptors



10.5.1.5 Conversion of NO_x to NO_2

The proportion of NO_2 in NO_x varies greatly with location and time according to several factors, including the amount of oxidant available and the distance from the emission source. NO_x concentrations are expected to decline in future years due to falling emissions, and the NO_2/NO_x ratio will likely increase. Also, a trend has been noted in recent years whereby roadside NO_2 concentrations have been increasing at specific roadside monitoring sites, despite emissions of NO_x falling. The direct NO_2 phenomenon is having an increasingly marked effect at many urban locations and must be considered when undertaking modelling studies

In this study modelled road-NO_x concentrations were converted to total NO_2 concentrations using Defra's 'NO_x to NO_2' calculator (V7.1) (DEFRA, 2019), released in April 2019. This calculator requires an estimate of the proportion of primary NO_2 (f-NO_2). This was calculated individually for each receptor based on the relative contribution of different sources to total locally generated NO_x concentrations. For road vehicles, representative values of f-NO_2 are contained within the 'NO_2 from NO_x calculator'. For aircraft, f-NO_2 values obtained from the National Atmospheric Emissions Inventory were used (NAEI, 2020). For all other sources, including APUs, GSE and terminal boiler plant, f-NO_2 values of either 5% or 15% were assumed.

The Year, Region and background NO_2 concentrations were specified in the calculator, as was the selection of "Newry and Morne" as a local authority to derive default values. It was also necessary to specify the "representative traffic mix"; this was assumed to be "all UK traffic". These assumptions have been based on guidance issued by National Roads Authority (ICAO, 2011).

10.5.1.6 Model Verification

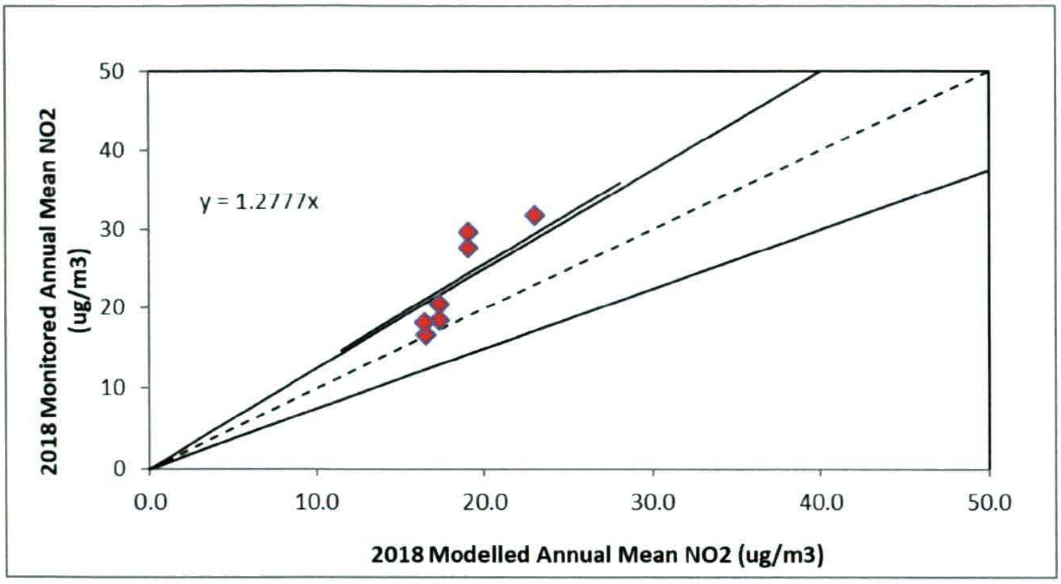
When using modelling techniques to predict concentrations, it is necessary to make a comparison between the modelling results and available measured monitoring data. This is to check if the model is reasonably reproducing actual observations and if necessary, allow the adjustment of modelled results to more closely match the monitoring data. The accuracy of the future year modelling results is relative to the accuracy of the base year results, therefore greater confidence can be placed in the future year concentrations if a good agreement is found for the base year.

The model has been run to predict the annual mean NO_x concentrations during 2018 at the Dublin Airport automatic monitor and the network of diffusion tube monitoring sites. Concentrations have been modelled at 2.4 m, the height of the monitors. A summary of the 2018 measured NO_2 concentrations is shown in Table 10-4.

Monitoring sites A9 andA10, and A3 and A7, have been excluded from the verification procedure. The first two are located in background locations further away from major Airport or road emissions, and the measured concentrations for 2018 are slightly lower than the background concentrations measured at EPA's Swords automatic monitoring station. The latter two have also been excluded as A3 is at a background location where the model over-predicts concentrations before any adjustment and site A7 is very close to the R108, which is not included in the model domain.

An initial comparison of the predicted NO_2 levels, based on combined "road-NO_x" and "airport-NO_x" emissions, which were converted into NO_2 using Defra's NO_x:NO_2 calculator and added to background values, with the measured NO_2 concentrations, shown an average under-prediction of 27.8% compared to measured concentrations, as can be seen in Figure 10-2:

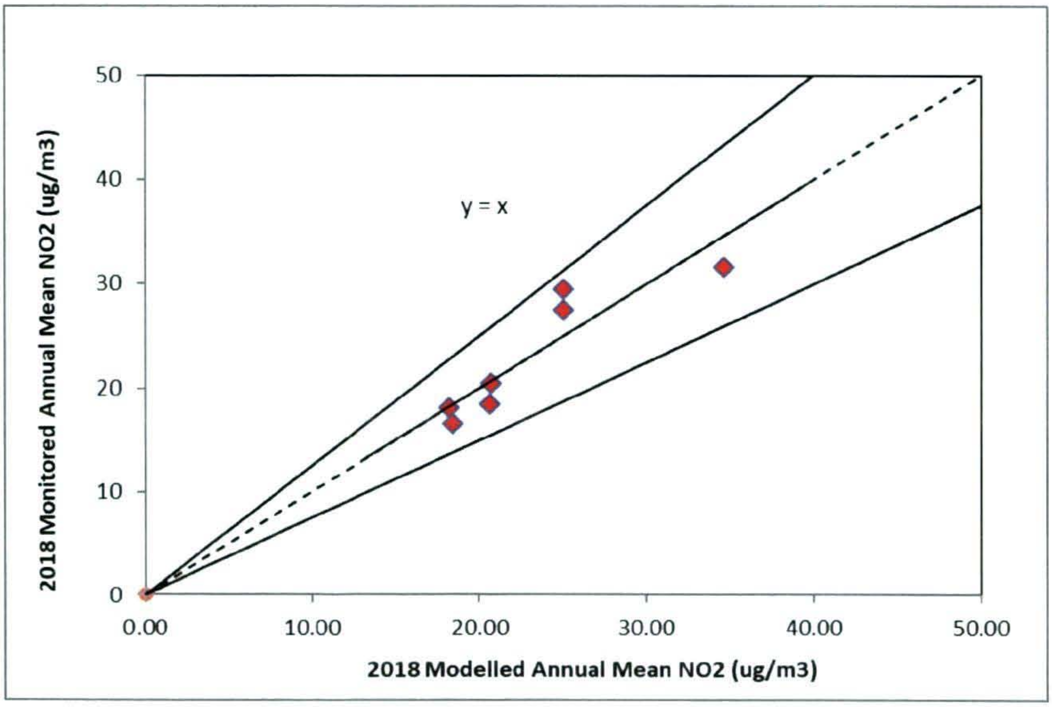
Figure 10-2 Modelled Vs Measured NO_2



The adjustment factor between modelled and monitored concentrations was found to be 2.551 to adjust the combined predicted "road-NO_x" and predicted "airport-NO_x". The factor was then applied to the modelled road-NO_x contribution at all receptor locations considered in this assessment, before being converted into total NO_2 concentrations, using again using the NO_x:NO_2 calculator. A comparison of predicted NO_2 with measured NO_2 indicates a secondary NO_2 adjustment of 1.06 is required.

Based on the final adjusted modelled NO_2 concentrations, the Root Mean Square Error (RMSE) is 2.5, the Fractional Bias is 0.0, and the correlation coefficient is 0.9. LAQM.TG16 provides guidance on the evaluation of model performance. Model outputs where the RMSE is above 25% of the Limit Value 10 µg/m^3 should be checked. It further notes that "ideally, an RMSE value with 10% of the Limit Value (4 µg/m^3) should be achieved" and the ideal value for the Fractional Bias is 0.0. Based on the aforementioned, the model performance is considered to be good. The final modelled vs measured NO_2 comparison is shown in Figure 10-3.

Figure 10-3: Adjusted Model Comparison



10.6 Assessment of Effects and Significance

10.6.1 Effects During Operation of Proposed Relevant Action

10.6.1.1 Nitrogen Dioxide (NO_2)

Predicted annual mean NO_2 concentrations for Permitted and Proposed scenarios and associated impacts are provided in Table C1 of Appendix A10-C (and section A3 of the Technical Appendix A10-A (Table A3.2 and Table A3.4)).

Table 10-12 summarises the number of receptors that are predicted to fall within the stated concentrations bands for NO_2. A concentration of less than 32 µg/m^3 annual mean NO_2 is predicted at all of the modelled receptors.

The year 2018 (Table B1 of Appendix A10-B and Table A3.1 of Technical Appendix A10-A) has been chosen as the baseline scenario to serve the verification purposes of the assessment, to match the most recent EPA monitoring data publicly available at the time of assessment (noting that the EPA have since published monitoring data for 2019, which is summarised in section *10.4 EPA Pollutant Monitoring*).

Table 10-12: Air Quality Statistics for NO_2 Concentrations at Assessed Receptor Locations

Annual Mean NO_2 (µg/m^3)	Number of Receptors in Each Concentration Band				
	2018	2022[1]		2025[2]	
	Baseline	Permitted	Proposed	Permitted	Proposed
<32	52	52	52	52	52
32 to 36	0	0	0	0	0
36 to 40	0	0	0	0	0
>40 (Limit Value)	0	0	0	0	0

Notes:
[1]Based on Pre-Covid-19 aircraft forecast data for 2022 (Proposed) (A)
[2]Based on Pre-Covid-19 aircraft forecast data for 2027 (Proposed) (A)

The highest predicted concentrations for the future proposed scenarios 2022, and 2025 are respectively 31.3 µg/m^3 (R5 at Creston Ave ~1.5km south of Dublin Airport) and 28.1 µg/m^3 (R32 at Forest Rd ~200m north of Dublin Airport). All of the predicted NO_2 levels fall well below the Limit Values.

Annual mean concentrations of NO_2 for the future proposed scenarios 2022 and 2025 increase in comparison with the same permitted scenarios at the worst affected location (R32) by 1.7 µg/m^3 and 1.9 µg/m^3 respectively, based on the conservative assumption of ATM emissions using pre-Covid forecast data.

10.6.1.2 Particulate Matter (PM)

Predicted annual mean PM_{10} and $PM_{2.5}$ concentrations for Permitted and Proposed scenarios and associated impacts are provided in Table C2 (PM_{10}) and Table C3 ($PM_{2.5}$) of Appendix A10-C (and section A3 of the Technical Appendix A10-A (PM_{10}: Table A3.6 and Table A3.8; $PM_{2.5}$: Table A3.10 and Table A3.12)).

Table 10-13 and Table 10-14 summarise the number of receptors that are predicted to fall within concentrations bands for PM_{10} and $PM_{2.5}$. No exceedances of the annual mean Limit Values for PM_{10} and $PM_{2.5}$ are predicted at any receptor locations across the detailed model area, and the values are all well below the annual mean Limit Values.

Table 10-13: Air Quality Statistics for PM_{10} Concentrations at Assessed Receptor Locations

Annual Mean PM_{10} ($\mu g/m^3$)	Number of Receptors in Each Concentration Band				
	2018	2022[1]		2025[2]	
	Baseline	Permitted	Proposed	Permitted	Proposed
<10	0	0	0	0	0
10 to 20	52	52	52	52	52
20 to 30	0	0	0	0	0
30 to 40	0	0	0	0	0
>40 (Limit Value)	0	0	0	0	0

Notes:
[1]Based on Pre-Covid-19 aircraft forecast data for 2022 (Proposed)
[2]Based on Pre-Covid-19 aircraft forecast data for 2027 (Proposed)

Table 10-14: Air Quality Statistics For $PM_{2.5}$ Concentrations at Assessed Receptor Locations

Annual Mean $PM_{2.5}$ ($\mu g/m^3$)	Number of Receptors in Each Concentration Band				
	2018	2022[1]		2025[2]	
	Baseline	Permitted	Proposed	Permitted	Proposed
<5	0	0	0	0	0
5 to 10	52	52	52	52	52
10 to 15	0	0	0	0	0
15 to 20	0	0	0	0	0
20 to 25	0	0	0	0	0
>25 (Limit Value)	0	0	0	0	0

Notes:
[1]Based on Pre-Covid-19 aircraft forecast data for 2022 (Proposed)
[2]Based on Pre-Covid-19 aircraft forecast data for 2027 (Proposed)

All 52 receptors are predicted to experience PM_{10} concentrations falling within the annual mean range of 10 to 20 $\mu g/m^3$. For $PM_{2.5}$, all 52 receptors lie within the annual mean range of 5 to 10 $\mu g/m^3$.

In both cases of pollutants, there is no change in the number of receptors in the concentration bands when passing from the permitted to the proposed scenarios. Predicted concentrations for both PM_{10} and $PM_{2.5}$ fall well below Limit Values for annual mean levels of 40 and 20 $\mu g/m^3$ respectively at all assessed receptor locations.

The highest predicted PM_{10} concentrations for the future proposed scenarios 2022 and 2025 are respectively 11.34 $\mu g/m^3$ and 10.99 $\mu g/m^3$ at location R5 (Creston Ave ~1.5km south of Dublin Airport). The biggest increase between the permitted and Proposed Scheme relevant year assessments are 0.07 $\mu g/m^3$ (R32) for 2022 and 0.07 $\mu g/m^3$ (also R32) for 2025.

The worst affected location for $PM_{2.5}$ was receptor (R8) with the predicted annual mean concentrations for the proposed scenarios reaching 7.01 $\mu g/m^3$ and 6.74 $\mu g/m^3$ for the assessment years 2022 and 2025 respectively. For 2022 and 2025, the highest observed increase between the permitted and Proposed Scheme relevant year scenarios are also respectively 0.07 $\mu g/m^3$ (R32) and 0.07 $\mu g/m^3$ (also R32).

10.6.1.3 Odour

Potential odour nuisance due to aircraft fuels has also been modelled, and the results can be seen in Table D-1 in Technical Appendix A10-D.

There is no standard assessment approach to quantify the potential odour effects associated with Airport operations. A commonly applied methodology is to define the odour levels based on the change in aircraft-related volatile organic compounds (VOC) emissions. However, there is no evidence to correlate total aircraft-related VOC concentrations with the human perception of odours. Furthermore, airport-odours are unlikely to be related to total VOCs, so any such correlation is expected to be very weak.

It becomes clear that according to the 98th percentile of the 1-hour mean exposure (OUe/m^3), no receptor is anticipated to experience levels > 1 OUe/m^3, thus the potential of odour nuisance occurring is low. The highest proposed predicted odour levels are 0.79 and 0.69 OUe/m^3 for years 2022 and 2025 respectively, all observed at receptor R8.

10.7 Additional Mitigation Measures

10.7.1 Mitigation During Operation of Proposed Relevant Action

No additional mitigation measures are anticipated to be required during the operation of the proposed Relevant Action.

10.8 Residual Effects and Conclusions

A highly conservative assessment of air quality impacts has been undertaken, based on pre-Covid forecast data, to represent permitted and proposed total pollutant concentrations and impacts for post-Covid scenarios. An analysis of ATM data between the pre-Covid forecast and post-Covid forecast has demonstrated that the proposed ATM (and therefore emissions associated with that ATM) of the former, as modelled, are higher than the ATM of the latter. Analysis has also demonstrated that the impact of the proposed Relevant Action on ATM (the change between permitted and proposed) is also much higher with the pre-Covid forecast data, as modelled. Therefore, the total pollutant concentrations and impacts reported in this chapter represent an extreme worst-case and in reality, total pollutant concentrations and impacts would be less than those reported.

The results of the conservative assessment demonstrate that annual mean concentrations of all the pollutants considered are below the relevant Limit Values for all of the assessed receptor locations.

Concentration changes between the permitted and proposed Relevant Action show residual effects to be Not Significant. A summary of the potential effect on air quality is shown in Table 10-15.

Table 10-15: Air Quality Summary Of Potential Effects

Description of Effect	*Sensitivity of Receptor*	*Nature of Effect / Geographic Scale*	*Magnitude of Impact*	*Initial Classification Of Effect (With Embedded Mitigation)*	*Additional Mitigation*	*Residual Effect Significance*
Complete and Occupied						
Changes in annual mean nitrogen dioxide (NO_2) concentrations	High	Permanent	Imperceptible	Not Significant	N/A	Not Significant
Changes in annual mean Particulate Matter (PM_{10}) concentrations	High	Permanent	Imperceptible	Not Significant	N/A	Not Significant
Changes in annual mean Particulate Matter ($PM_{2.5}$) concentrations	High	Permanent	Imperceptible	Not Significant	N/A	Not Significant
Changes in 98th percentile of 1-hour mean odour concentrations	High	Permanent	Imperceptible	Not Significant	N/A	Not Significant

10.8.1 Likely Significant Environmental Effects

The proposed Relevant Action is unlikely to generate any significant effects on air quality, even with the conservative (i.e worst case) assumptions modelled for future aircraft forecasts.

Chapter 11: Climate

11

11. Climate and Carbon

11.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) reports the findings of an assessment of the likely significant effects on greenhouse gas (GHG) emissions as a result of the proposed Relevant Action.

The scope of the GHG assessment includes additional GHG emissions resulting from the variation in Air Traffic Movements (ATMs) reported in the aircraft schedule developed by Mott MacDonald. GHG emissions from ATMs that have been considered within this assessment include those from the Landing and Take-Off (LTO) cycle (i.e. activities including approach/ landing, taxiing, take-off and climb (up to 3,000 feet), including Auxiliary Power Units (APUs) where applicable, and also during the Climb, Cruise and Descent (CCD) phase for departing flights. Additional surface access passenger journeys as a result of the proposed Relevant Action are also included within the scope of the assessment.

This assessment and EIAR chapter has been produced by AECOM.

11.2 Legislation and Planning Policy Context

The various policies, standards and guidance described in this section outline national and international ambitions and targets for reducing GHG emissions and demonstrate the need for effective GHG reduction measures to be built into future development.

In line with these ambitions and targets, this assessment evaluates the GHG impact of the proposed Relevant Action in the context of the projected National Emissions Inventories for Ireland (EPA, 2019) to provide some context and scale in relation to Ireland's trajectory towards decarbonisation.

Section 11.5 Environmental Design and Management outlines the ways in which GHG emissions as a result of the proposed Relevant Action have been or will be avoided, prevented, reduced and offset by various means.

11.2.1 National Planning Policy

11.2.1.1 National Policy Position on Climate Action and Low Carbon Development (2015)

The National Policy Position (DCCAE, 2013) outlines a requirement for relevant bodies to, "*in the performance of [their] functions, have regard to [...] the objective of mitigating greenhouse gas emissions and adapting to the effects of climate change in the State*". The policy position provides a high-level policy direction for the adoption and implementation by Government of plans to enable the State to move to a low carbon economy by 2050. Specifically, it suggests the road-mapping and policy development process will be guided by a long-term vision based on:

- An aggregate reduction in carbon dioxide (CO_2) emissions of at least 80% (compared to 1990 levels) by 2050 across the electricity generation, built environment and transport sectors; and
- In parallel, an approach to carbon neutrality in the agriculture and land-use sector, including forestry, which does not compromise capacity for sustainable food production.

The projected National Emissions Inventories for Ireland (EPA, 2019), used within this assessment to evaluate the impact of GHG emissions associated with the proposed Relevant Action on Ireland's ability to meet its carbon reduction targets, were developed in line with this 80% reduction in GHG emissions target.

The draft 2020 amendment (DCCAE, 2020) introduces;

- Ireland's 5 yearly carbon budgets, to start in 2021.
- A requirement for a climate neutral economy by 2050
- Expectation for local authority to develop Climate Action Plans

11.2.1.2 National Spatial Strategy for Ireland 2002-2020

The National Spatial Strategy for Ireland 2002-2020 (Government of Ireland, 2002) highlights the importance of limiting energy demand and CO_2 emissions as a result of the development of Ireland's transport networks and encourages promotion of forestry and initiatives to address the impact of transport on the environment.

11.2.1.3 Project Ireland 2040: National Planning Framework (2018)

The NPF (Government of Ireland, 2018a) discusses the need to reduce GHG emissions.

The Framework also describes the importance of progressively electrifying mobility systems, moving away from "*polluting and carbon intensive propulsion systems to new technologies*".

11.2.1.4 National Development Plan 2018-2027

The National Development Plan 2018-2027 (Government of Ireland, 2018b) sets out the investment priorities that will underpin the implementation of the National Planning Framework (above). This Development Plan emphasises the need for "*investment to support the achievement of climate action objectives and discourage investment in high-carbon technologies*".

11.2.1.5 National Aviation Policy (2015)

The National Aviation Policy (DTTS, 2015) describes GHG emissions as a key issue in relation to aviation and states that while fuel efficiency has increased significantly in recent decades (70% increase in the last 40 years), these improvements are being offset by a rapid increase in activity.

It is recognised that aviation emissions will need to be limited in the future in line with European and global emissions trading/ offsetting initiatives.

11.2.1.6 Climate Action Plan (2019)

The objective of the Climate Action Plan (DCCAE, 2019) is to enable Ireland to meet its EU targets to reduce its carbon emissions by 30 per cent between 2021 and 2030 and lay the foundations for achieving net zero carbon emissions by 2050. The Plan outlines 180 actions that need to be taken across all the key sectors.

Specifically in relation to the transport sector, key actions include encouraging the uptake of biofuels, among others. Non transport-specific targets include increasing carbon tax.

While the Climate Action Plan is described as 'laying the foundations' for net zero carbon emissions by 2050, an official net zero target has not yet been set. Therefore, the net zero target does not supersede the 80% GHG emissions reduction target outlined within the National Policy Position on Climate Action and Low Carbon Development, described above. The 80% emissions reduction target has therefore been used for the purposes of this assessment.

11.2.2 Local Planning Policy

11.2.2.1 Transport Strategy for the Greater Dublin Area 2016-2035

This Transport Strategy (NTA, 2016a) emphasises Ireland's need to "*radically reduce dependence on carbon-emitting fuels in the transport sector*".

11.2.2.2 Dublin City Development Plan 2016-2022

The Dublin City Development Plan (DCC, 2016) explains that Dublin City has set an ambitious target of a 20% reduction in GHG emissions compared with 1990 levels for the whole city and a 33% reduction for the Council's own energy by 2020, and the EU Mayors Adapt Initiative has agreed to reduce carbon dioxide emissions by at least 40% by 2030.

11.2.2.3 Dublin City Council Climate Change Action Plan 2019-2024

The Dublin City Council Climate Action Plan (DCC, 2019) looks at the current climate change impacts and GHG emissions levels in the city, then features a range of actions to reduce these impacts across five key areas - Energy and Buildings, Transport, Flood Resilience, Nature-Based Solutions and Resource Management. A key target of the Climate Action Plan is to achieve a 40% reduction in the Council's greenhouse gas emissions by 2030.

11.2.2.4 Fingal Development Plan 2017-2023

The Fingal Development Plan (FCC, 2017) describes the need to "*minimise the County's contribution to climate change*", with particular reference to the transport sector, among others.

11.2.2.5 Fingal County Council Climate Change Action Plan 2019-2024

The Fingal County Council Climate Action Plan (FCC, 2019), developed alongside the Dublin City Council Climate Action Plan described above, looks at the current and future climate change impacts and GHG emissions levels within the county, and features a range of actions to reduce these impacts across five key areas - Energy and Buildings, Transport, Flood Resilience, Nature-Based Solutions and Resource Management. A key target of the Climate Action Plan is to achieve a 40% reduction in the Council's greenhouse gas emissions by 2030.

The Council also "*recognises the Climate Emergency as declared by the Dáil and commits itself in this plan to prioritising mitigation of, and adaptation to, climate change across its functions*".

11.2.3 Other Relevant Policy, Standards and Guidance

11.2.3.1 European Union (EU) Directive 2014/52/EU

The EU Directive 2014/52/EU (EU, 2014) describes the importance of considering climate change and greenhouse gas emissions within EIAs; "*Climate change will continue to cause damage to the environment and compromise economic development. In this regard, it is appropriate to assess the impact of projects on climate (for example greenhouse gas emissions) and their vulnerability to climate change.*"

11.2.3.2 European Union Emission Trading Scheme

The aim of the EU Emissions Trading Scheme (ETS) (EC, 2015) is to help EU Member States achieve their commitments to limit or reduce greenhouse gas emissions in a cost-effective way by allowing participating companies to buy or sell emissions credits. This means savings are made where it is most financially viable to do so.

CO_2 emissions from aviation have been included in the EU emissions trading scheme since 2012. Under the EU ETS all airlines operating in Euro (both European and non-European airlines) are required to monitor, report and verify their emissions, and to surrender allowances against those emissions. They receive tradeable allowances covering a certain level of permitted emissions from their flights each year.

The EU ETS is discussed further in Section 11.5 Environmental Design and Management in relation to offsetting aviation emissions within the EU.

11.2.3.3 International Civil Aviation Organisation (ICAO) Carbon Offsetting Reduction Scheme for International Aviation (CORSIA)

CORSIA (ICAO, 2016) has been developed to address the increase in total CO_2 emissions from international aviation, with the aim of achieving no net increase in aircraft CO_2 emissions from its implementation date of 2021.

As it currently stands, CO_2 emissions from international aviation in 2019 will be used to set the CORSIA baseline for carbon neutral growth post-2020[9]. In any year beyond this point, any international aviation CO_2 emissions covered by the scheme exceeding the baseline quantity will be required to be offset.

CORSIA will be implemented in phases, starting with participation of countries on a voluntary basis until 2026, followed by the second phase (from 2027 to 2035), whereby participation is mandatory for all countries except those which are exempt (i.e. Least Developed Countries (LDCs), Small Island Developing States (SIDS) and Landlocked Developing Countries (LLDCs)).

CORSIA is discussed further in Section 11.5 Environmental Design and Management in relation to offsetting international aviation emissions.

11.3 Assessment Methodology

This section of this EIAR chapter presents the following:

- Information sources that have been consulted throughout the preparation of this chapter;
- Details of consultation undertaken with respect to GHG emissions;

[9] Due to the global COVID-19 pandemic resulting in significantly reduced international aviation operations in 2020, the CORSIA emissions baseline was adjusted. Without this adjustment, the baseline would have been much lower than expected, which would "*disrespect the originally-agreed intention and objectives of ICAO's 193 Member States when they adopted CORSIA in October 2016*", according to ICAO.

- The methodology behind the assessment of effects of GHG emissions, including the criteria for the determination of sensitivity of receptor and magnitude of change from the existing 'baseline' condition;
- An explanation as to how the identification and assessment of potential effects of GHG emissions has been reached; and
- The significance criteria and terminology for the assessment of residual effects of GHG emissions.

11.3.1 Methodology for Determining Baseline Conditions and Sensitive Receptors

The GHG assessment study area considers all GHG emissions from fuel used by aircraft during the additional LTO and CCD phases (collectively referred to as ATMs) and from additional surface access passenger journeys as a result of the proposed Relevant Action.

Only departure flights are considered within this assessment to avoid double counting of aviation emissions between airports. It is assumed that the emissions associated with the arriving flights, above 3000ft, will be accounted for within the carbon accounts of the airports of origin.

The baseline for the GHG emissions assessment is a 'business-as-usual' scenario (i.e. the GHG emissions associated with the forecast ATMs and surface access passenger journeys), without the proposed Relevant Action (the 'permitted / constrained' scenario).

The global climate has been identified as the receptor for the purposes of the GHG emissions assessment. However, there is no specific criteria for determining the significance of GHG emissions.

There is currently no published standard definition for receptor sensitivity to GHG emissions. For the purposes of this assessment, the sensitivity of the receptor, the Irish National Emissions Inventory[10] (used here as a proxy for the global climate to contextualise the scale of the GHG impact), has been defined as 'high'. The rationale for this approach is as follows:

- The extreme importance of limiting global warming to below 2°C this century is broadly asserted by the International Paris Agreement (UNFCC, 2016) and the climate science community. Additionally, a recent report by the Intergovernmental Panel on Climate Change (IPCC) highlighted the importance of limiting global warming below 1.5°C (IPCC, 2018).

11.3.2 Methodology for Determining Construction Effects

The proposed Relevant Action will result in no changes to the design or construction methodology of the North Runway the construction of which is already underway. On that basis, the assessment of construction phase impacts on GHG emissions is not assed further within this EIAR.

11.3.3 Methodology for Determining Operational Effects

There is no new airport infrastructure proposed as part of the proposed Relevant Action. Emissions from the operation of airport buildings and assets are therefore expected to remain similar to the current operations. It is expected that any increase in operational emissions due to an increase in night flights as a result of the proposed Relevant Action will be counterbalanced by the decarbonisation of the national grid and further carbon reductions realised in line with daa's energy reduction targets. It is therefore anticipated that any changes to building operations as a result of the proposed Relevant Action will not have a material impact on the overall carbon footprint and the outcome of this assessment. Emissions associated with operation of airport buildings/ assets are therefore not assessed any further within this EIAR.

Based on the project description and the scope of the proposed Relevant Action, the assessment of the impacts of ATMs and additional surface access passenger journeys on GHG emissions have been included in the assessment.

In line with the approach adopted for the Aviation Emissions Calculator by the European Monitoring and Evaluation Programme (EMEP) and the European Environment Agency (EEA) (EMP/EEA, 2019), the GHG emissions

[10] While it is recognised that the Irish National Emissions Inventory does not include emissions from international aviation, it has been used here as a proxy for the global climate to contextualise the scale of the GHG impact in relation to Ireland's projected trajectory towards decarbonisation.

associated with ATMs will be reported as tonnes of carbon dioxide (tCO_2). However, the GHG emissions associated with the additional surface access passenger journeys will be reported as tonnes of carbon dioxide equivalent (tCO_2e), accounting for the following seven Kyoto Protocol GHGs in line with 'The GHG Protocol' (WBCSD & WRI, n,d):

1. Carbon dioxide (CO_2).
2. Methane (CH_4).
3. Nitrous oxide (N_2O).
4. Sulphur hexafluoride (SF_6).
5. Hydrofluorocarbons (HFCs).
6. Perfluorocarbons (PFCs).
7. Nitrogen trifluoride (NF_3).

Other aircraft engine emissions (oxides of nitrogen (NO_x) and methane (CH_4)), and contrail and cirrus cloud formation have a climate change effect when released at high altitudes (Lee et al., 2009). It has been suggested by researchers that this additional effect almost doubles aviation's contribution to climate change compared to the CO_2 emissions alone (Sausen et al., 2005). However, the science is uncertain, and these additional impacts are not included in EU or international policy making at present. Therefore, these effects are not considered when calculating ATM emissions.

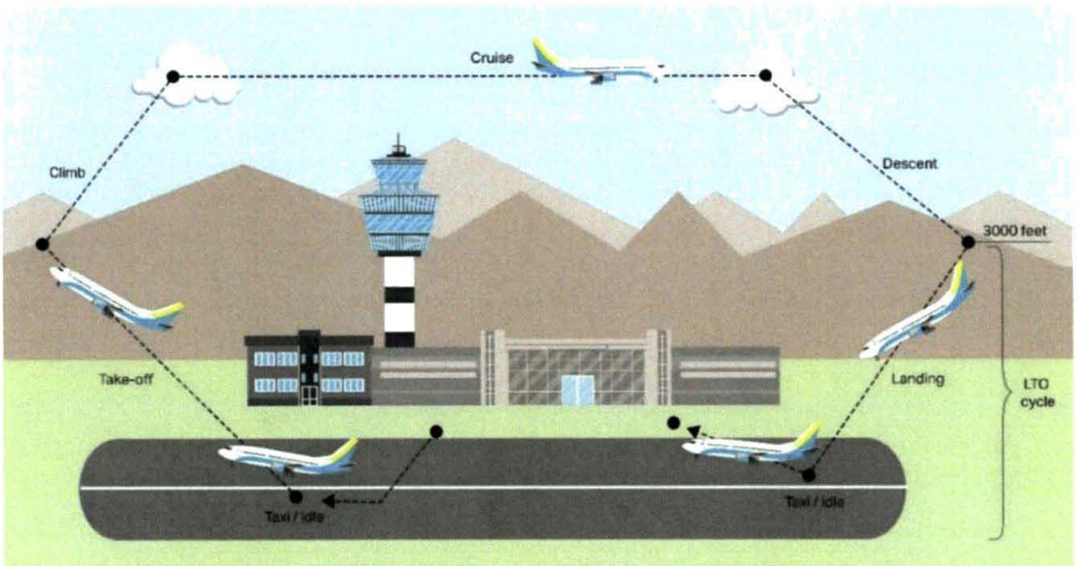


Figure 11-1 Air Traffic Movement (ATM) phases, including Landing and Take-Off (LTO) and Climb, Cruise and Descent (CCD) phases

As defined by ICAO, the LTO cycle consists of four phases of aircraft operations: approach/ landing, taxi, take-off and climb (to 3,000 feet), while the CCD phase consists of the climb, cruise and descent stages for departing flights only (above 3,000 feet).

Projected ATM data developed by Mott MacDonald (displayed in Table 11-1) have been provided for 2022 and 2025 for the 'proposed / unconstrained' and 'permitted / constrained' scenarios, representing airport operations with and without the proposed Relevant Action, respectively. Emissions from ATMs have been calculated for each of these future scenarios using the Aviation Emissions Calculator (EMEP/ EEA, 2019), based on the specific flight schedule and aircraft mix provided. As the aircraft schedules provided contain the projected mix of aircraft models for each of the assessment scenarios, future efficiency gains due to new aircraft models have been accounted for.

The calculator draws on the International Civil Aviation Organisation (ICAO) *Aircraft Engine Emissions Databank*, which contains information on exhaust emissions from various aircraft engines (provided by engine manufacturers).

The calculator models emissions from various aircraft types based on their most frequently used engine types and average European taxi times provided by EUROCONTROL's Central Office of Delay Analysis (CODA).

Table 11-1 Permitted/Constrained and Proposed/Unconstrained annual ATM projections for each assessment year

Year	Scenario		
	Permitted/Constrained	Proposed/Unconstrained	Variation
2022	223,000	229,000	6,000
2025	233,000	241,000	8,000

The Aviation Emissions Calculator methodology does not account for APU use as the use of APUs is highly variable between airports. APU usage at individual airports may depend on site-specific APU restrictions, differences in fuel costs between APUs and alternative power sources, and availability of alternative power sources (e.g. due to proximity of the aircraft to the required airport infrastructure). To account for APU usage, a scaling factor[11] of 8% has been applied to the LTO emissions calculated using the Aviation Emissions Calculator (EMP/EEA, 2019). This scaling factor is a conservative estimate, based on the contribution of APU emissions to overall LTO emissions reported in Heathrow Airport's emissions inventory between 2013 and 2017 (Heathrow Airport Limited, 2018).

Data from Heathrow Airport has been used here as the specific inventory data required for this calculation is not available for Dublin Airport over such a period (5 years), and there is very limited data or guidance available within the literature due to the high variability in APU usage between airports. As APU usage as a proportion of overall LTO emissions is publicly available for Heathrow Airport, this has been used as a proxy for Dublin. It is recognised that this may not be a completely accurate representation of the contribution of APU emissions at Dublin Airport, however as the APU usage only accounts for a small proportion of overall ATM emissions, it is not anticipated that any variation in APU use between Heathrow Airport and Dublin Airport will have an impact the overall outcome of the assessment.

The flight distance between Dublin Airport and each destination airport has been estimated for each flight route, and the emissions from each ATM modelled individually using the Aviation Emissions Calculator. To estimate the flight route distances, the direct distance was obtained from the Great Circle Mapper air distance calculator (Great Circle Mapper, 2020), and an 8% uplift was applied to CCD emissions to account for deviations from the direct route due to inclement weather conditions and stacking above airports, as per the Defra 2020 emissions factor calculation methodology (Defra, 2018).

The 8% scaling factor from the Defra 2020 guidance has been applied here as it is the most up-to-date source available, and the guidance states that following recent analysis, this factor is deemed the most appropriate for flights arriving and departing in the UK. It is assumed that in the context of worldwide airport operations, operations at Dublin Airport would be similar enough to UK airports for this to also be applicable here. An alternative to this scaling factor is a factor of 10% as reported in the IPCC Aviation and the Global Atmosphere report (1999) (IPPC, 1999), however considering the age of the underlying data built into the IPCC scaling factor and how much the aviation industry has changed over the last 20 years, the Defra scaling factor is considered a more appropriate and accurate estimate.

Projected passenger numbers for each of the assessment scenarios reported in the Dublin Airport Operating Restrictions report (Mott MacDonald, 2020) have been used to estimate GHG emissions associated with additional surface access passenger journeys, based on assumptions[12] made around mode of travel and transportation distances, and applying the relevant Defra 2020 emissions factors (Defra, 2020).

11.3.4 Significance Criteria

There are no specific criteria for determining the significance of GHG emissions. The IEMA guidance on GHG in EIA (IEMA, 2017) states that *'any GHG emissions or reductions from a project might be considered to be significant'*. As such, the projected National Emissions Inventories for Ireland (EPA, 2019), as compiled by the EPA, have been used as a proxy for the level of effect of GHG emissions as a result of the proposed Relevant Action on the global climate. Consideration has also been given to the transportation sector within the projected National

[11] A scaling factor is a number which multiplies a quantity by a given amount to estimate another quantity based on the proportionate relationship between the two aspects. In this case, LTO emissions have been scaled up to include an additional 8% of total LTO emissions to account for emissions from APU usage. The 8% factor is based on the relationship between LTO and APU emissions at Heathrow Airport.

[12] Specific assumptions are outlined in the *Limitations and Assumptions* section below.

Emissions Inventories for Ireland to help contextualise the GHG emissions and provide an idea of scale. Additional GHG emissions as a result of the proposed Relevant Action have also been considered in the context of Ireland's carbon reduction ambitions.

In the absence of specific criteria for defining the significance of GHG emissions, the IEMA guidance suggests that professional judgement should be used to contextualise the GHG impact. In GHG accounting it is common practice to consider exclusion of emission sources that are <1% of a given emissions inventory on the basis of a 'de minimis' contribution. The PAS 2050 Specification for the assessment of the life cycle greenhouse gas emissions of goods and services (2011), published by the British Standards Institute (BSI, 2011), allows emissions sources of <1% contribution to be excluded from emission inventories, and for these inventories to still be considered complete for verification purposes.

Therefore, for the purposes of this assessment, where total annual emissions from the operation of the proposed Relevant Action are equal to or more than 1% of the projected total annual Emissions Inventory for Ireland, they will be considered to be of major significance. Where total annual emissions from the operation of the proposed Relevant Action are less than 1% of the projected total annual Emissions Inventory for Ireland, they will be considered to be of minor significance.

11.3.5 Methodology to Assess the Significance of Effects

The significance of effect will be determined based on the variation of GHG emissions between the permitted / constrained and proposed / unconstrained operations. The difference between the GHG emissions associated with the permitted / constrained and proposed / unconstrained operations is considered to represent the emissions arising as a result of the proposed Relevant Action and therefore equates to the GHG impact.

The variation in emissions between the permitted / constrained and proposed / unconstrained operations has been compared against Ireland's projected total National Emissions Inventories and projected total Transport Emissions Inventories for each of the assessment years, and the transport emissions level required to meet Irelands target of an aggregate reduction in carbon dioxide (CO_2) emissions of at least 80% (compared to 1990 levels) by 2050 across the electricity generation, built environment and transport sectors.

It should be noted that these emissions inventory and carbon reduction target figures do not include emissions from international aviation. However, these figures provide an insight into the scale of the impact of the proposed Relevant Action. Specific mechanisms for reducing international aviation emissions (e.g. EU ETS and CORSIA) are described in *Section 11.5 Environmental Design and Management*.

11.3.6 Limitations and Assumptions

Only commercial flights have been included in the ATM GHG emissions calculations, while flights made by private aircraft have been excluded. It is anticipated that GHG emissions from private aircraft would not have a material impact on the overall GHG footprint.

Aircraft schedule forecasts (produced by Mott MacDonald) have been provided for a peak day (as defined within Chapter 13 Air Noise and Vibration, and within the Mott MacDonald Report. The aircraft mix on the peak day has been assumed to be representative of the aircraft mix throughout the year. To calculate annual emissions, the aircraft and ATM schedule produced by Mott MacDonald has been prorated up based on the number of ATMs for the peak day and the total annual ATMs.

Some aircraft models (typically newer models) were not available within the Aviation Emissions Calculator (EMP/EEA, 2019). For the A320neo and A321neo, the A320 and A321 models were used instead. These emissions were then prorated down based on the difference in emissions intensity between the relevant models, as calculated using the Atmosfair Flight Emissions Calculator (Atmosfair, 2020). Where certain aircraft models were not available within either the Aviation Emissions Calculator or the Atmosfair calculator, the closest available model produced by the same manufacturer was selected as a proxy.

For some flights, the total journey length reported in the aircraft schedule exceeded the range limit of the proxy aircraft selected. In this instance, emissions were calculated for the maximum available journey length for the proxy aircraft within the Aviation Emissions Calculator, then scaled up proportionately to account for the total journey distance.

As APU usage is difficult to estimate accurately for individual airports due to the highly variable nature, the calculations for the GHG emissions associated with APU usage assume an 8% uplift on total LTO emissions excluding APU (as calculated using the Aviation Emissions Calculator). This uplift is considered to represent a conservative approach (i.e. the 5-year average APU uplift from the Heathrow Airport data has been rounded up, so may be over-estimating APU emissions).

An 8% uplift has also been applied to CCD emissions to account for deviations from the ideal flight route due to inclement weather conditions and stacking above airports. This is in line with the methodology described by Defra (Defra, 2018).

No assumptions regarding future biofuel use have been factored into the ATM GHG emissions calculations due to uncertainty around the level of uptake in the future[13]. This is considered to represent a conservative approach.

Table 11-2 outlines the mode share percentages (as reported for Dublin Airport in the 2016 National Transport Authority Passenger Survey (NTA, 2016b), journey distances assumed, and Defra 2020 emissions factors applied for the calculation of GHG emissions associated with surface access passenger journeys. The mode share percentages reported are assumed to be the same for each of the assessment years. Any variation between these figures and actual mode share figures for each of the assessment years is not anticipated to have a material impact in the context of the overall footprint, and is therefore not anticipated to affect the overall outcome of the assessment.

Table 11-2 Assumptions made for the calculation of GHG emissions associated with surface access passenger journeys

Transport mode	Assumptions		
	Mode share	Assumed 2-way distance (km)	Emissions factor applied
Bus/ coach	32.6%	60	Defra 2020 - Local bus (not London)
Taxi	25.3%	100	Defra 2020 - Large car - Unknown fuel
Passenger in car	15.8%		N/A
Own car/ van	14%	100	Defra 2020 - Average car - Unknown fuel
Rental car/ van	6.4%	100	Defra 2020 - Average car - Unknown fuel
Hotel shuttle bus	4.2%	60	Defra 2020 - Local bus (not London)
Bicycle	0.1%		N/A
On foot	0.2%		N/A
Other	1.4%	100	Defra 2020 - Average car - Unknown fuel

11.4 Baseline Conditions

The baseline for the GHG impact assessment is the North Runway Permission, i.e the permitted / constrained scenario, assuming the proposed Relevant Action does not receive permission. The quantity of GHG emissions would therefore remain unchanged from the permitted / constrained scenario.

This baseline is compared against the proposed / unconstrained scenario, and the difference between the permitted / constrained and proposed / unconstrained scenarios for each of the assessment years (2022 and 2025) is considered to be the GHG impact.

11.4.1 Future Baseline

The projected emissions for permitted / constrained operations in 2022 (the year in which the North Runway is anticipated to become operational) and 2025 (the year in which 32mppa is expected to be reached) represent the future baseline.

11.5 Environmental Design and Management

During the option selection process, multiple alternative options for the proposed Relevant Action were appraised based on a number of environmental criteria to reduce the overall environmental impact. GHG emission impacts

[13] The International Energy Agency (IEA) states that while the aviation industry demonstrates a strong commitment to sustainable alternative fuels such as biofuels, further technological developments are required before widespread uptake is realistic: https://www.iea.org/commentaries/are-aviation-biofuels-ready-for-take-off

were included within this options appraisal, which found that each of the options for any of the environmental impacts considered were in the same order of magnitude, except for noise impacts. More information on this process can be found in *Chapter 4 Alternatives*.

This section identifies further ways in which GHG emissions from aircraft ATMs have been or will be avoided, prevented, reduced and offset by various means.

Efficiencies have historically reduced the CO_2 intensity of aircraft, and these efficiencies are expected to continue. The estimated fuel efficiency benefits from switching to more fuel-efficient aircraft models in the future have been incorporated into this GHG assessment.

Market based measures such as EU ETS and ICAO's CORSIA scheme will also impact international aviation emissions, with the ETS providing a cap on intra-EU aviation emissions to 2020 and post-2020 and CORSIA aiming for no net increase in aircraft CO_2 emissions from its implementation date of 2021.

The impacts of these market-based measures have not been incorporated into the GHG calculations presented within this chapter - all calculations are gross emissions prior to these measures reducing or off-setting the total emissions. However, the EU ETS and CORSIA will mean any emissions over the level permitted will be offset through those schemes.

Scope 3[14] (indirect) aircraft emissions are outside daa direct control but can be influenced by efficient airside infrastructure design and delivery and services such as Fixed Electrical Ground Power (provided by daa) and how aircraft operate at the Airport (influenced by airlines, the Air Navigation Service Provider and daa). One such example is Airport Collaborative Decision Making (A-CDM) which Dublin Airport is implementing. This brings all stakeholders together to improve the efficiency of the airside operations at the airport. daa is also certified under Level 2 of the Airport Carbon Accreditation scheme and is planning to move to Level 3 of the scheme shortly.

11.6 Assessment of Effects and Significance

11.6.1 Effects During Operation of Proposed Relevant Action

11.6.1.1 GHG Emissions for the Permitted/Constrained and Proposed/Unconstrained Operations

Table 11-3, Table 11-4, Table 11-5 and Table 11-6 present the projected CO_2 emissions associated with the LTO cycle, CCD phase, surface access passenger journeys and total GHG emissions, respectively, for the permitted and proposed operations for each of the assessment years. The variation in emissions between the permitted and proposed operations represents the additional emissions as a result of the proposed Relevant Action.

Table 11-3 LTO emissions projections – Permitted / Constrained vs Proposed / Unconstrained Operations

Year	LTO emissions (tCO_2)			
	Permitted / Constrained	Proposed / Unconstrained	Variation	% variation (Permitted / Constrained to Proposed / Unconstrained)
2022	301,980	312,322	**10,342**	3.4%
2025	321,269	333,474	**12,206**	3.8%

Table 11-4 CCD Emissions Projections – Permitted / Constrained vs Proposed / Unconstrained Operations

Year	CCD emissions (tCO2)			
	Permitted / Constrained	Proposed / Unconstrained	Variation	% variation (Permitted / Constrained to Proposed / Unconstrained)
2022	**2,179,127**	2,305,340	**126,213**	5.8%
2025	**2,608,410**	2,766,197	**157,788**	6.0%

[14] Scope 3 emissions are defined within the Greenhouse Gas Protocol corporate accounting and reporting standard as indirect GHG emissions that occur as "*a consequence of the activities of the company, but occur from sources not owned or controlled by the company*".

Table 11-5 Surface Access Passenger Journey Emissions Projections – Permitted / Constrained vs Proposed / Unconstrained Operations

Year	Surface access passenger journey emissions (tCO_2e)			
	Permitted / Constrained	Proposed / Unconstrained	Variation	% variation (Permitted / Constrained to Proposed/Unconstrained)
2022	431,996	445,543	**13,547**	3.1%
2025	465,110	481,668	**16,557**	3.6%

Table 11-6 Total Annual GHG Emissions Projections – Permitted / Constrained vs Proposed / Unconstrained Operations

Year	Total annual GHG emissions (tCO_2e[15])			
	Permitted / Constrained	Proposed / Unconstrained	Variation	% variation (Permitted / Constrained to Proposed / Unconstrained)
2022	2,913,104	3,063,205	**150,102**	5.2%
2025	3,394,789	3,581,339	**186,551**	5.5%

11.6.2 Assessment of Significance of Effects

Additional GHG emissions arising as a result of the proposed Relevant Action are considered to have a direct, negative effect on the receptor. The effects of GHG emissions are also considered to be long term, irreversible and have the potential to be cumulative with other projects. In terms of effect significance, IEMA (IEMA, 2017) suggests that *"GHG emissions have a combined environmental effect that is approaching a scientifically defined environmental limit, as such any GHG emissions or reduction from a project might be considered significant."*

As described in *Section 11.3 Assessment Methodology*, the impact of the proposed Relevant Action has been compared with Ireland's projected National Emissions Inventories for each of the assessment years (under the With Additional Measures scenario) (EPA, 2019) to determine the level of significance (see Table 11-7). The impact of the proposed Relevant Action has been further contextualised by comparing the CO_2 emissions with the projected Transport Emissions Inventories for each of the assessment years (under the With Additional Measures scenario), and with Ireland's transport sector emissions requirements if the 2050 target is to be met (see Table 11-8).

Table 11-7 GHG Emissions Against Future National Emissions Inventory Scenarios

Year	Emissions (kt CO_2e)	Projected national emissions inventory (kt CO_2e)	Emissions as a % of national emissions inventory	Significance
2022	150.1	61,510	0.244%	Minor
2025	186.6	61,430	0.304%	Minor

Note: While emissions are reported in $ktCO_2e$, the aviation emissions included within the total only account for CO_2 emissions.

Table 11-8 GHG Emissions Against Future Transport Emissions Inventory Scenarios

Year	Emissions (kt CO_2e)	Projected/ required transport emissions inventory (kt CO_2e)	Emissions as a % of transport emissions inventory
2022	150.1	12,970	1.16%
2025	186.6	12,490	1.49%
2050	186.6[16]	1,000	18.66%

Note: While emissions are reported in $ktCO_2e$, the aviation emissions included within the total only account for CO_2 emissions.

[15] *Note: While this is reported in tCO_2e, the aviation emissions included within this total only account for CO_2 emissions.*
[16] GHG emissions as a result of the proposed Relevant Action have not been modelled beyond 2025, so the 2025 figure has been used here for comparison with the 2050 transport emissions target.

As the GHG emissions associated with the proposed Relevant Action do not represent ≥1% of the projected National Emissions Inventory for either of the assessment years, GHG emissions are considered to be of **minor significance.**

11.7 Additional Mitigation Measures

11.7.1 Mitigation During Operation of Proposed Relevant Action

Section 11.5 Environmental Design and Management identifies ways in which GHG emissions from aircraft ATMs have been or will be avoided, prevented, reduced and offset by various means. For example, aircrafts are anticipated to become more fuel efficient over time as new technologies become available, and implementation of A-CDM at Dublin Airport is expected to improve the efficiency of the airside operations at the airport by facilitating collaboration between stakeholders at the airport.

Section 11.5 Environmental Design and Management also describes various market-based measures such as EU ETS and CORSIA, which put a cap on emissions within their respective geographical spheres of influence, to drive carbon reductions in the most effective and cost-effective areas through emissions trading and offsetting between airports.

No additional mitigation and monitoring beyond the measures already described in *Section 11.5 Environmental Design and Management* are required once the proposed Relevant Action is complete and operational.

11.8 Residual Effects and Conclusions

This section identifies the residual effects, following the implementation of mitigation and monitoring measures, known as 'residual effects' which cannot be eliminated through design changes or the application of standard mitigation measures.

There will be unavoidable GHG emissions resulting from the operational phase of the proposed Relevant Action. However, as the effects are considered to be of **minor significance**, it is not appropriate to define any mitigation measures further to the ones detailed in Section 11.5 Environmental Design and Management.

Table 11-9 *Climate Change Summary of Potential Effects*

Description of Effect	Sensitivity of Receptor	Nature of Effect / Geographic Scale	Magnitude of Impact	Initial Classification of Effect (with embedded mitigation)	Additional Mitigation	Residual Effect Significance
Complete and Occupied						
	High	long-term/ Global	Low	Minor	None	Minor (Low significance)

11.8.1 Likely Significant Environmental Effects

The significance of the GHG emissions impact of the proposed Relevant Action considering the receptor's sensitivity (global climate) is anticipated to be minor, which is considered to be of low significance.

Chapter 12:

Water

12

12. Water

12.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) provides baseline information in relation to water and assesses the potential impacts and effects of the proposed Relevant Action on the water environment.

12.2 Legislation and Planning Policy Context

12.2.1 Legislation

The following legislation is relevant to this chapter and has been considered during the assessment presented within it:

The following legislation is relevant to this chapter and has been considered during the assessment presented within it:

- EIA Directive
- European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296 of 2018))
- European Union Water Framework Directive (WFD) (2000/60/EC), which was adopted as a single piece of legislation covering rivers, lakes, groundwater and transitional (estuarine) and coastal waters. The following legislation in Ireland governs the shape of the WFD characterisation, monitoring and status assessment programs in terms of monitoring different water categories, determining the quality elements and undertaking characterisation and classification assessments:
  - European Communities (Water Policy) Regulations, 2003 (S.I. No. 722 of 2003)
  - European Communities Environmental Objectives (Surface Water) Regulations, 2009 ('S.I. No. 272 of 2009) as amended in 2012 (by S.I. No. 327/2012), 2015 (by S.I. No. 386/2015) and 2019 (by S.I. No. 77/2019)
- The EU Floods Directive 2007/60/EC
- European Communities (Assessment and Management of Flood Risks) Regulations, 2010 (S.I. No. 122 of 2010)
- River Basin Management Plan 2018-2021 (DHPLG, 2018)
- The Planning & Development Acts 2000 to 2020;
- Fisheries Acts 1959 to 2019;
- Inland Fisheries Acts 1959 to 2017; and,
- Local Government (Water Pollution Acts) 1977-2007.

12.2.2 National Planning Policy

The following national planning policy is also relevant to this chapter and has been considered throughout the assessment presented within it:

- Project Ireland 2040 – National Planning Framework (2018).

12.2.3 Regional and Local Planning Policy

The following local planning policy is considered relevant to this assessment.

- Regional Spatial & Economic Strategy for the Eastern and Midland Region 2019-2031;
- Fingal Development Plan 2017-2023; and,

- Dublin Airport Local Area Plan (2020).

12.2.4 Relevant Guidance

The following guidance documents are considered relevant to this assessment.

- Draft Environmental Protection Agency (EPA) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2017);
- Relevant Irish governmental guidance such as that available online from the National Parks and Wildlife Service (NPWS);
- Various National Roads Authority (now Transport Infrastructure Ireland) guidance from the 'Environmental Planning and Construction Guidelines', including the *Guidelines for Assessment of Ecological Impacts from National Road Schemes* (NRA, 2009);
- Greater Dublin Strategic Drainage Study Final Strategy Report (Dublin Drainage, April 2005);
- Greater Dublin Strategic Drainage Study – Regional Drainage Policies – Volume 2 – New Development, (Dublin Drainage, March 2005); and
- Greater Dublin Regional Code of Practice for Drainage Works Version 6.0.

12.3 Assessment Methodology

12.3.1 Study Area

North Runway is currently an active construction site operating within a Construction Environmental Management Plan. Operational discharges at the airport continue to be controlled under extant trade effluent licence. The study area for surface water receptors encompasses the airport. For groundwater, the buffer area will extend to 500 m from the airport boundary. There are no sensitive water environment features within the Study Area although the Cuckoo Stream flows west to east through the airport.

12.3.2 Methodology for Determining Baseline Conditions and Sensitive Receptors

The existing water environment has been determined from desktop review, site walkovers and site studies/investigations, as follows:

- Aquatic & Hydrological studies;
- Ordnance Survey Ireland (OSI) website for historical maps of 1:2,500 scale and 1:10,560 scale and aerial photographs;
- OSI discovery series of 1:50,000 scale;
- GSI website for public viewer and groundwater maps;
- EPA website Envision;
- Local authority web portals;
- Topography maps;
- Flood information mapping; and
- Existing site investigation information.

Receptors have been identified during the baseline study and a qualitative assessment has been used to assign a sensitivity rating from negligible to high based on the EPA EIAR guidance (EPA, 2017) and considers their likely adaptability, tolerance and recoverability.

12.3.3 Methodology for Determining Construction Effects

The proposed Relevant Action will result in no additional infrastructure, no changes to the design, construction, catchment area, hydrology, flow control, or approach to operation of pollution control of North Runway itself or any of the wider pollution control infrastructure at the airport. Due to there being no change in the extent of excavation required and no change in physical infrastructure (including drainage) the proposed Relevant Action will not result in new environmental effects to the water environment.

12.3.4 Methodology for Determining Operational Effects

The proposed Relevant Action will not alter the current operational drainage systems and de-icing operations at the airport. An understanding of these operations is provided below.

There are two separate and distinct drainage catchments related to de-icing. These are the runways/taxiways and the apron/stand areas.

12.3.5 Runways and Taxiways

The North Runway pollution system is designed to control pavement de-icer run-off from the North Runway itself, and associated taxiways. These areas of the airfield are de-iced when temperatures fall to 0°C or below. Given the relatively low number of frost nights at Dublin Airport, the frequency of de-icing is low. The extent of de-icing undertaken is independent of the time of day or the usage of the runway. The volume of de-icing fluid and therefore the volume of potentially contaminated surface water arising is directly related to the area of the runways/taxiways being de-iced and subsequent rainfall and is independent of the number of aircraft using the runway system. The design criteria for the pollution control system on the runway is not affected by the runway usage patterns. There will be no changes to the runway drainage system as a result of the proposed Relevant Action.

Once construction of North Runway is completed, run-off from the paved areas will be continuously monitored via online Total Organic Carbon (TOC) analysers (allows for low levels of assessment and irregular flows in the network) to measure TOC values which shall be calibrated to equivalent Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) limits to measure compliance with permitted discharge levels. If monitoring shows that the surface water is contaminated, it will be automatically diverted to the polluted water holding tank (PWHT). The control system for the tank discharge will include failsafe mechanisms to ensure that there is no accidental release of contaminated water into receiving waterways.

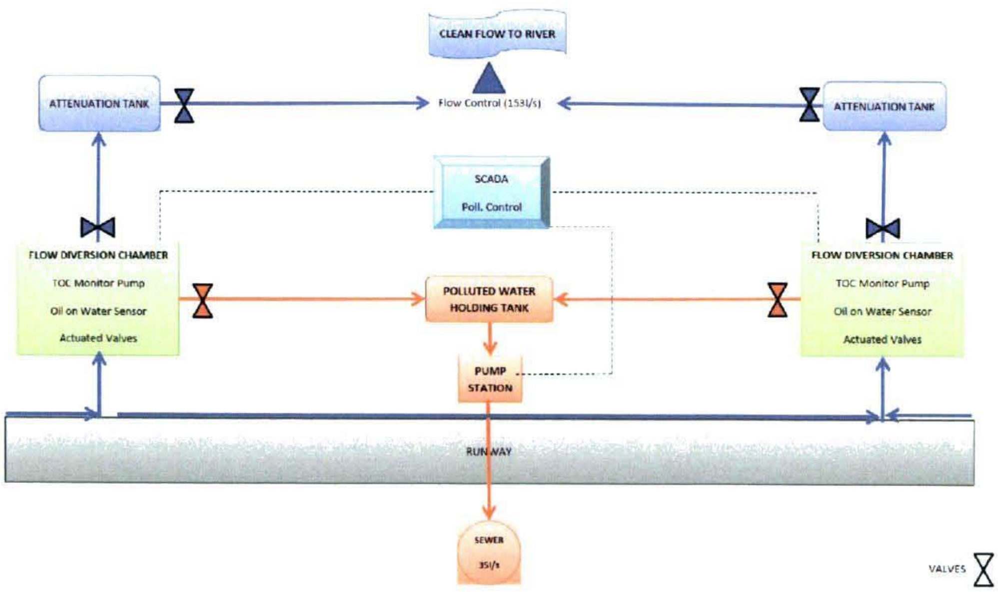


Figure 12-1 Illustrated Drainage Flow

There will also be no change in the frequency of de-icing events, stormwater run-off volumes, attenuation discharge rates, attenuation volume requirements, or proposed discharge locations. For these reasons, drainage relating to the runways/taxiways will remain unchanged and can be scoped out of the EIAR. As a result of the above, it is anticipated that there will be no significant effects arising due to the proposed Relevant Action.

12.3.6 Aprons/Stands

As well as de-icing the runway, departing aircraft are generally de-iced when the air temperature reaches 3 degrees C or lower. All aircraft are de-iced while stationary on their stands prior to departure/pushback. The areas around these stands drain to an existing pollution control facility located within the airfield which discharges to the North Fringe foul sewer under licence. As such, the proposed changes to the operating restrictions of the runways will not result in any change to the current location or extent of the area where aircraft de-icing takes place. There are no new aircraft stands proposed as part of this application and the proposed Relevant Action will not result in any changes to the existing drainage system. For this reason, the drainage infrastructure relating to the aprons/stands will remain unchanged as a result of the proposed Relevant Action and drainage can be screened out of the EIAR. Any future stands or pier developments at the airport will assess drainage in an appropriate level of detail at the time of the development of such infrastructure.

As described above, there would be no amendments to surface water drainage operation relative to that already consented in the 2007 (and amended in 2020) planning permission for North Runway. The proposed Relevant Action will not significantly affect important water environment features during operation as a result of surface water pollution.

12.3.7 Significance Criteria

On the basis that there will be no changes to the design or construction of North Runway, and that the proposed Relevant Action will not result in any changes to the operation of North Runway which could result in significant impacts, it can be concluded that there will be no significant effects from the proposed Relevant Action on the water environment.

12.3.8 Limitations and Assumptions

There are no significant limitations to the assessment of potential effects on water environment features presented in this chapter.

12.4 Environmental Design and Management

The operation of the de-icing & pollution control system is described above. This will be in place in both the permitted / constrained and proposed / unconstrained scenarios.

12.5 Assessment of Effects and Significance

At the time of writing, North Runway was an active construction site operating with a Construction Environmental Management Plan. As there are no sensitive water environment features within the Study Area which will be subject to significant impacts, no detailed assessment of effects is required.

An understanding of how the drainage systems and de-icing operations in use at the airport operate, as provided above, clearly demonstrates that there is no potential for likely significant adverse effects associated with the proposed Relevant Action in terms of drainage.

The Cuckoo Stream, which flows west to east through the airport, discharges into Baldoyle Bay Estuary Special Area of Conservation (SAC). The Cuckoo Stream is unlikely to have any important fisheries or invertebrate populations, due to its legacy of historically poor water quality (Q2-3 when last monitored in 2016, but always ≤Q3 since monitoring started in 1988). The most recent monitoring data available, from June 2019, shows that it is still failing to meet 'good' status. The proposed Relevant Action would not have any effect upon the condition or status of the Cuckoo Stream under the Water Framework Directive (WFD).

The primary threat to water quality as a result of the operating system at the airport, has previously been identified as the application of de-icing chemicals following snow or frost events. It is anticipated however that the permitted

North Runway drainage system, once constructed, is likely to represent an improvement on the current pollution management with its dedicated pollution control and attenuation system. This will be in place in both the permitted / constrained and proposed / unconstrained scenarios and the proposed Relevant Action does not affect this.

Table 12-1 and

Table 12-2 below set out the predicted scenarios where the water environment might be affected by the proposed Relevant Action, and a summary of the effect is described.

Table 12-1 North Runway specific details

Scenario	With North Runway Condition 3d and 5 Restrictions (permitted / constrained scenario)	Without North Runway Conditions 3d and 5 Restrictions (propsoed / unconstrained scenario)
Biological loading to sewer	Approx. 100-200 mg/l COD, and BOD of 80 to 150mg/l to sewer	No change. Approx. 100-200 mg/l COD to sewer and BOD of 80 to 150mg/l to sewer
Hydraulic loading	Greenfield run-off rates (see Q100 rates (Figure 12-2 below))	No change Greenfield run-off rates (see Q100 rates (Figure 12-2 below))
Area of Infrastructure	362,400 m2 runway and taxiway paved area	No change to runway and taxiway paved area of 362,400 m2
Estimated extent of de-icer use	3000-5000 litres of pavement de-icer on runway per application No aircraft de-icing takes place in North Runway catchment	No change to 3000-5000 litres of pavement de-icer on runway per application. No aircraft de-icing takes place in North Runway catchment
Irish Water (IW) agreement with regard flows	35 l/s as agreed with IW in letter of support dated 24th October 2016. To be finalised with trade effluent discharge licence and Planning Condition 21 discharge	No change to 35 l/s as agreed in draft agreement. To be finalised with trade effluent discharge licence and Planning Condition 21 discharge
IFI agreement with regard streams	5mg/l BOD winter as per planning approval	No change to 5mg/l BOD winter as per planning approval

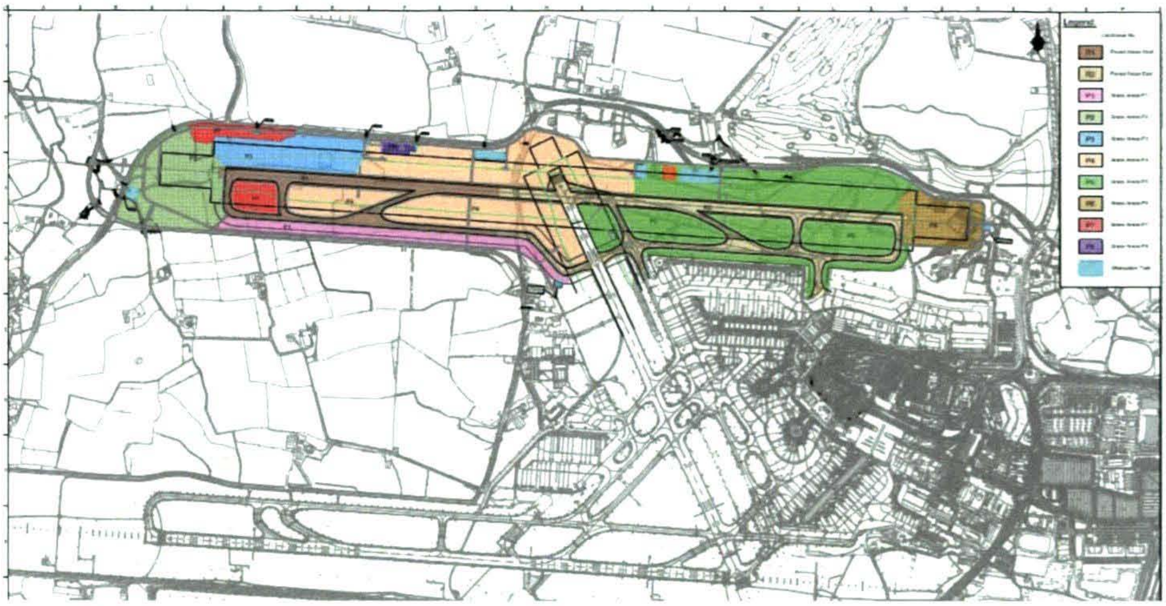


Figure 12-2 Q100 Rates Proposed Catchment Areas

Table 12-2 Existing catchment details

Scenario	With North Runway Condition 3d and 5 Restrictions	Without North Runway Conditions 3d and 5 Restrictions
Biological loading	As per existing trade effluent discharge licence (TEDL)	No change. As per existing trade effluent discharge licence
Hydraulic loading	As per existing drainage network. No new infrastructure in this catchment as part of the Relevant Action application	No change. As per existing drainage network. No new infrastructure in this catchment as part of the Relevant Action application
Area of Infrastructure	-=	No change
Estimated extent of de-icer use	Pavement de-icer used for existing runways and taxiways as required based on weather conditions. Aircraft de-icing on stand dependent on air tempertures. De-icing required for departing aircraft only and can occur any time of day but mostly for first wave of departures in 0600 to 0800 period. 65 movements permitted in 2300 to 0700 hour. Many of the flights that cannot be accomodated in the 0600-0700 hour are not lost completely but will depart at less preferred time after 0700 due to the restrictions. They remain part of the first wave and continue to require de-icing in that period also.	No change to pavement de-icing on existing runway and taxiways Approximately 100 movements in the 2300 to 0700 period and some reduction in the numbers in the 0700 to 0800 period as they can now be accomodated at their preferred departure time. Therefore the actual amount of additional aircraft de-icing is not significant and continues on the same stands as today and no additional infrastructure required. Therefore no significant additional run-off.
IW agreement with regard flows	As per TEDL	No change as result of proposed restriction changes
IFI agreement with regard streams	None at present	No change as part of this project

12.6 Additional Mitigation Measures

As the proposed Relevant Action will not result in any significant effects on surface water environment and drainage, there is no requirement for mitigation to be implemented.

12.7 Residual Effects and Conclusions

There are no residual significant effects on the surface water environment and drainage from the proposed Relevant Action.

Chapter 13:

Aircraft Noise and Vibration (Air)

13

13. Air Noise and Vibration

13.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) reports the findings of an assessment of the likely significant effects from air noise and vibration from aircraft as a result of the proposed Relevant Action, which is described in Chapter 2.

This assessment and EIAR chapter have been produced by Bickerdike Allen Partners LLP.

Air noise and vibration specifically encompasses noise and vibration associated with flights into and out of Dublin Airport while airborne or using the runway system, including any start of roll or reverse thrust activities but excluding noise and vibration related to any other aircraft ground operations such as taxiing and when aircraft are on stands, which are covered in Chapter 14.

Road traffic noise effects have not been assessed for this application, as the Relevant Action is not forecast to cause any significant changes to the road traffic flows in the vicinity of the airport, either when considering the 24-hour period or the night period (23:00 to 07:00). The changes to road traffic flows are discussed in more detail in Chapter 9.

This chapter has considered future forecast scenarios for the selected years of 2022, when the North Runway is scheduled to open, and 2025, the first subsequent year when 32 mppa is expected to be reached; 2025 is therefore expected to constitute a worst case scenario for this Relevant Action application.

For each of the two selected years, this chapter has compared the scenario with the Relevant Action, referred to as the "2022 Relevant Action" and "2025 Relevant Action" scenarios, with three situations:

- The actual situation in 2018, referred to in this chapter as "2018 Baseline".
- The forecast situation in the corresponding future year, with the North Runway operational and the current conditions in place, referred to in this chapter as the "2022 Baseline" and "2025 Baseline" scenarios.
- The situation that was forecast for 2025 as part of the North Runway planning process in 2004-2007, referred to in this chapter as the "2025 Consented" scenario.

13.1.1 Summary of the proposed Relevant Action

The relevant noise related operating restrictions which currently apply to the North Runway Permission (FCC Reg) are set out in full in Chapter 2. In summary they provide as follows:

- No use of the North Runway at night (23:00 to 07:00). This is provided for in Condition 3d of the North Runway Permission.
- The Crosswind Runway can be only used for essential purposes. This is provided for in Condition 4 of the North Runway Permission.
- A limit on the number of aircraft movements at the airport at night (23:00 to 07:00) to 65/night. This is provided for in Condition 5 of the North Runway Permission.

The proposed Relevant Action is to remove Condition 5 of the North Runway Permission and to replace it with an annual night-time noise quota between 23:30 and 06:00, and also to amend Condition 3d to allow flights to take off from and/or land on the North Runway for an additional 2 hours i.e. 23:00 to 00:00 and 06:00 to 07:00, with the permitted operation in these 2 additional hours being the same as during the daytime hours when the North Runway is already permitted to be used. Overall, this would allow for an increase in the number of flights taking off and/or landing at Dublin Airport between 23:00 and 07:00.

No change is proposed to the permitted passenger capacity which is limited to 32 million passengers per annum (mppa) in the terminals nor is there any proposed change to the permitted operation of the runway system during daytime hours (Option 7b).

13.1.1.1 Option 7b – Conditions 3(a) to 3(c) of the North Runway Permission

The Relevant Action does not alter Conditions 3(a) to (c) of the North Runway Permission which together describe the preferred runway concept put forward in the original North Runway planning process of 2004-2007, known as Option 7b:

> *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*

In summary Option 7b provides that the arrivals from the east and departures to the east shall prefer to use the South Runway. Arrivals from the west and departures to the west can use the North Runway or South Runway as determined by air traffic control.

In practice it is expected that air traffic control will prefer to use one runway for arrivals and the other for departures, subject to capacity constraints, and therefore most of the time the North Runway will be preferred for departures to the west and the South Runway will be preferred for arrivals from the west. This is however sensitive to the precise timing of flights, particularly in the busy early morning period of 06:00-08:00, so there is potential for departures off both runways in this period.

13.2 Legislation and Planning Policy Context

The Environmental Impact Assessment (EIA) process is described in Chapter 1 of this EIAR. This notes that the EIA requirements derive from Council Directive 85/337/EEC and sets out the EIA regulations and EPA guidelines that were considered by AECOM in preparing this EIAR.

Chapter 6 of this EIAR sets out the legislative and planning policy context for the proposed Relevant Action. It includes reference to relevant national and local planning policies, including those that have been considered when determining the EIAR scope, method and mitigation. Those considered relevant to this chapter are summarised below with additional material also considered relevant. More detail on this additional material, and selected policies included in Chapter 6, are given in Appendix 13A.

13.2.1 Strategic Planning Context

daa has a number of obligations to fulfil with regard to the management of Dublin Airport. These and the overall framework the airport operates under are set out in the following:

- Section 23(1) of the Air Navigation and Transport (Amendment) Act 1998
- S.I. No. 549/2018– Environmental Noise Regulations 2018 (Government of Ireland, 2018)
- Aircraft Noise (Dublin Airport) Regulation Act, 2019 (Government of Ireland, 2018)

The last of these implements EU Regulation 598/2014 (European Commission, 2014) on the establishment of rules and procedures with regard to the introduction of noise related operating restrictions at European Union Airports within the ICAO Balanced Approach (ICAO, 2010). Further details of this regulation, and the two listed above are contained in Appendix 13A.

13.2.2 National Planning Policy

The following national planning policy is considered relevant to this assessment.

- National Aviation Policy for Ireland (2015) (DTTS, 2015)

- Project Ireland 2040 – National Planning Framework (2018) (Government of Ireland, 2018b)

13.2.3 Local Planning Policy

The following local planning policy is considered relevant to this assessment.

- Fingal Development Plan 2017-2023 (FCC, 2017)
- Dublin Airport Local Area Plan (2020) (FCC, 2020)
- Noise Action Plan for Dublin Airport (2019-2023) (FCC, 2019)

13.2.4 Relevant UK Policy, Standards and Guidance

The following UK policies, standards and guidance documents are considered relevant to this assessment. More detail is given in Appendix 13A.

- National Planning Policy Framework (NPPF, 2020)
- Noise Policy Statement for England (2010) (DEFRA, 2010)
- National Planning Practice Guidance ((DEFRA, 2019)
- UK Aviation Policy Framework (2013) (DfT, 2013)
- Survey of Noise Attitudes 2014 (2017) (UKCAA, 2017)
- UK Airspace Policy: A framework for balanced decisions on the design and use of airspace 2017 consultation (DfT, 2017)
- Aviation 2050 (DfT, 2018)
- BS 8233:2014 Sound insulation and noise reduction in buildings – code of practice (BSI, 2014)
- Department of Education - Acoustic design of schools: performance standards BB93 (2015) (DoE, 2015)
- Department of Health - Specialist Services, Health Technical Memorandum 08-01: Acoustics (2013) (DoH, 2013)
- CAP1616a Airspace Change: Environmental requirements technical annex (CAA, 2020)
- BS7445 Description and measurement of environmental noise BSI, 2003)

13.2.5 Other International Policy, Standards and Guidance

The following other international policies, standards and guidance documents are considered relevant to this assessment. More detail is given in Appendix 13A.

- ICAO Balanced Approach (ICAO, 2010)
- ICAO Convention on International Civil Aviation, Annex 16, Volume 1 (ICAO, 2014)
- Environmental Noise Directive 2002/49/EC (EC, 2002)
- EU Commission Directive 2020/367 (EC, 2020)
- WHO Guidelines for community noise (1999) (Berglund, B. *et al,* 1999)
- WHO Night Noise Guidelines for Europe (2009) (WHO, 2009)
- WHO Environmental Noise Guidelines for the European Region (2018) (WHO, 2018)

13.3 Assessment Methodology

This section of this EIAR chapter describes the approach to the assessment of the air noise effects, covering the following:

- Information sources that have been consulted throughout the preparation of this chapter;
- The methodology behind the assessment of air noise and vibration effects, including the criteria for the determination of sensitivity of receptor and magnitude of change from the existing or 'baseline' condition;

- An explanation as to how the identification and assessment of potential air noise and vibration effects has been reached; and
- The significance criteria and terminology for the assessment of air noise and vibration residual effects.

Key sources of information that have been utilised for this assessment are as follows:

- The physical location of the runway system.
- Flight paths, in particular for departures. This information for existing routes has been taken from a combination of the Aeronautical Information Publication (AIP) for Ireland and an inspection of actual aircraft flight paths using the airport's Noise and Flight Track Monitoring System (NFTMS). Representative future routes for noise modelling purposes have been developed based on the 2016 public consultation for flight paths and ongoing consultation with the Irish Aviation Authority (IAA);
- The number of flights in each relevant assessment period, including their aircraft type, operation, and destination. This has been supplied by daa for both actual (e.g. 2018) and forecast scenarios (forecasts were prepared by Mott Macdonald).

13.3.1 Air Noise Modelling Methodology

The assessment of air noise relies heavily on the modelling of noise levels. This has been carried out using the noise modelling software produced by the Federal Aviation Administration (FAA), the Aviation Environmental Design Tool (AEDT). This industry standard software evaluates aircraft noise in the vicinity of airports based on aircraft type, operation, route, and flight profile, as well as taking into account local terrain and meteorological information. This software is used to produce noise contours and to predict noise levels at specific locations. The model has been validated by taking into account the measurements recorded by Dublin Airport's Noise and Flight Track Monitoring System (NFTMS). Details of the modelling methodology are given in Appendix 13B.

The aircraft movements assessed as part of the air noise assessment include all aircraft taking off from or landing at Dublin Airport, with the exception of helicopter and military aircraft. Operations by helicopter and military aircraft make up a very small proportion of the total and are not able to be assessed to the same level of accuracy. For example, in 2018 there were 820 operations by helicopters and 2 operations by military aircraft, making up 0.4% of the total. As a result, their inclusion would have a negligible effect on the findings of this assessment.

13.3.2 Primary Assessment Metrics

There are various noise metrics available for the assessment of the impacts of air noise. These are described in detail in Appendix 13A. The metrics used here include those that have been used previously to rate air noise around Dublin Airport, as used currently in the UK and also those used around Europe for strategic noise mapping purposes and in noise action plans. Whilst other metrics have been considered in this assessment, emphasis has been placed on the European noise metrics, i.e.:

- L_{den}, which takes into account the annual activity throughout the 24-hour period, with a 5 dB penalty applied to noise in the evening (19:00-23:00) period and a 10 dB penalty applied to noise in the night (23:00-07:00) period. The key effect linked with this metric is annoyance.
- L_{night}, which takes into account the annual activity during the night (23:00-07:00) period. The key effect linked with this metric is sleep disturbance.

These two metrics are required to be used in order to comply with the requirements of EU Regulation 598/2014, and are the metrics used for strategic noise mapping as required under the Environmental Noise Regulations (S.I. No. 140/2006) in Ireland.

The number of people 'highly sleep disturbed' and 'highly annoyed' has also been predicted in accordance with the approach recommended by the World Health Organisation's Environmental Noise Guidelines 2018 as endorsed by the European Commission through Directive 2020/367.

13.3.3 Supplementary Noise Metrics

The primary air noise assessment metrics generally rely on extensive surveying of attitudes to aircraft noise resulting in a dose-response relationship linking levels of community annoyance to the metric. In addition, as used previously in the assessment of air noise around Dublin Airport, noise contours have been prepared in terms of the established UK noise metrics for air noise, the $L_{Aeq,16h}$ metric for the daytime (07:00-23:00) period and the $L_{Aeq,8h}$

metric for the night-time (23:00-07:00) period. These periods relate to an average summer day. Summer in this instance is defined as the 92-day period between 16 June and 15 September inclusive.

Some other supplementary air noise metrics, while having limited research into correlation with community annoyance, can be useful in reflecting how aircraft noise is experienced in the locality around an airport and these are also presented here.

The following supplementary noise metrics have been presented to contextualise the noise around Dublin Airport associated with the Relevant Action:

- The summer $L_{Aeq,16h}$ and $L_{Aeq,8h}$ metrics. These describe the average noise level during a summer day (07:00-23:00) and summer night (23:00-07:00) respectively.
- The annual L_{day} and $L_{evening}$ metrics which are optional under EU Regulation 598/2014. These describe the average noise level during an annual day (07:00-19:00) and evening (19:00-23:00) respectively.
- N65 and N60 indices. N65 for example indicates the number of times a threshold level of 65 dB L_{Amax} is exceeded within the time period of interest and has been determined for the summer daytime period. The N60 has been determined for the summer night-time period.
- SEL and L_{Amax}, which are commonly used to rate the impacts of noise from individual aircraft operations at night.

13.3.4 Methodology for Determining Baseline Conditions and Sensitive Receptors

The study area is based on the largest extent of likely impacts due to air noise, i.e. encompassing an envelope formed by the lowest value noise contours assessed for each metric. The extents of the study area are contained within a rectangle that extends 53 km to the west, 49 km to the east, 32 km to the north and 25 km to the south of the centre of the existing main runway at Dublin Airport.

There are a number of relevant scenarios which could be considered to be the baseline. Firstly there is the situation prior to the making of this application for the proposed Relevant Action, for which information for the actual situation in both 2018 and 2019 has been provided. 2018 was the last full year with a throughput of close to but less than 32mppa at the airport, and therefore this is used for the comparisons with future years. Given that aircraft activity and resulting noise impacts were less in 2018 than 2019, this allows for a conservative comparison with the future scenarios. The chapter also considers the forecast situation in the future years of 2022 and 2025, with the North Runway operational and the current conditions in place.

At the time of the North Runway planning process in 2004-2007, future forecasts were made of the night-time situation that would likely arise in 2025 in a 'constrained' scenario which was defined at that time as the scenario predicted to occur without North Runway being developed. This scenario equated to 65 flights per night in the 92-day summer period using the existing (south) runway in 2025 and no use of the North Runway. In terms of noise exposure, this 'constrained' scenario can be seen as equivalent to a consented night-time scenario with Condition 3(d) and 5 in place, where there is a 65 movement cap at the airport and no use of the North Runway or the crosswind runway at night.

This scenario, referred to in this chapter as "2025 Consented", has been modelled using the same modelling methodology as that for the other scenarios given in this chapter. The movements by aircraft type, runway, route and stage length have been taken from the 2004-2007 North Runway planning process. Specifically, these were given in the document *"Response to Information Request by An Bord Pleanala of 9th January 2007"*, pages 25-32. The forecast annual ATMs presented in the 2004-2007 planning process were around 348,000, and the daytime assessments were all based on this total. However no consideration was given to the potential impact on ATMs of Conditions 3(d) and 5. Applying these conditions would reduce the forecasted annual ATMs from around 348,000 to around 307,000 in this scenario. For the purposes of this assessment, the previously modelled flights have therefore been scaled down to this figure.

The following have been considered as potential receptors of high sensitivity for this assessment:

- Dwellings;
- Schools;
- Residential healthcare facilities and

- Places of worship.

Receptors with a lower sensitivity to noise, such as offices and hotels, have not been considered as part of this assessment.

The assessment of dwellings includes an allowance for those which are consented but not yet constructed, including land zoned for residential development. These have been presented separately to the totals for existing dwellings.

13.3.5 Methodology for Determining Construction Effects

As the proposed Relevant Action will result in no changes to the design or construction of the North Runway, the proposed Relevant Action will not cause any construction noise impacts .

13.3.6 Methodology for Determining Operational Effects

The Regulation 598 assessment considered a number of different options for the use of the runway system at night. The resulting chosen option, presented in this chapter as the "Relevant Action" scenario, involves the preferred runway concept used in the daytime (07:00 to 23:00), known as Option 7b, being used in the periods of 23:00 to 00:00 and 06:00 to 07:00. The limit of 65 flights per night (23:00 to 07:00) is also removed and replaced with a Quota Count limit.

The effects of the Relevant Action are determined by comparing this scenario with the baseline for 2018, the future baseline for the relevant year with the current conditions in place, and the 2025 Consented scenario based on the 2007 North Runway application. Based on the number of flights in the forecast, the expectation is that in the "Relevant Action" scenarios which are based on Option 7b, all departures in the periods of 23:00 to 00:00 and 06:00 to 07:00 will use the North Runway for westerly operations, and the South Runway for Easterly operations, with arrivals using the opposite runway.

The following future years have been assessed:

- 2022 – the year the North Runway is expected to open; and
- 2025 – the first year following the opening of the North Runway when 32 mppa is expected to be reached.

The assessment in this chapter considers 2022 and 2025. These represent the year of opening, and the likely worst-case future year. After 2025, the noise impacts are expected to reduce if the airport remains at 32 mppa due to the forecast fleet renewal which will lead to the average aircraft getting quieter.

The general assessment methodology involves the following:

- Derivation of assessment criteria;
- Computation of existing and future noise levels under the various scenarios;
- Assessment of magnitude of impacts (absolute) on sensitive receptors, for each scenario;
- Determination of the change in noise levels, and associated impacts (relative) as a result of the Relevant Action;
- Consideration of the likely significant effects of the Relevant Action, based on both the absolute and relative noise levels;
- Description of the potential effects (beneficial and adverse) associated with the Relevant Action; and
- Description of any mitigation measures, where appropriate, in relation to the Relevant Action and a description of any residual effects.

13.3.7 Significance Criteria – Air Noise

The air noise effects are considered in terms of both the absolute noise level and the change in noise level due to the Relevant Action in order to determine the significance of the effects due to the Relevant Action. Both need to be considered to determine whether a significant effect arises from the Relevant Action in an EIA context; for example if a receptor experiences a high absolute noise level but no change due to the Relevant Action then this is not a significant effect. Conversely if a receptor experiences a large change in noise level but the resulting level is still very low then this receptor is not considered to be significantly affected.

13.3.7.1 Residential Receptors

Absolute noise impacts for residential receptors have been developed against an effect scale and are given in Table 13-1. The derivation of these is discussed in Appendix 13A.

Table 13-1: Air Noise Impact Criteria (absolute) – residential

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

The effect scale used to assess the change in noise level is given in Table 13-2. A semantic scale of this type, following the format of examples given in the Institute of Environmental Management and Assessment (IEMA) guidelines, has been applied in previous air noise assessments and accepted in Public Inquiries for airport developments in the UK and Ireland, for example the application for the North Runway at Dublin Airport. The thresholds are derived from the difference contour bands recommended in CAP1616a (DoH, 2013).

Table 13-2: Air Noise Impact Criteria (relative)

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

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

There is no clearly accepted method of how to rate the magnitude of the effect of a change in the absolute air noise level and the associated change in noise level. Some guidance however has been provided in the UK's National Planning Practice Guidance (NPPG, 2020) which states:

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

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

Table 13-3 shows how the absolute and relative impacts are interpreted into magnitude of effect. This takes into account the criteria presented above, other guidance and professional judgement. The effect rating scale is taken from the EPA Draft EIAR Guidelines (EPA, 2017).

Table 13-3: Summary of magnitude of effect – air noise

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

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

A potential significant effect (adverse or beneficial) would be considered to arise if in Table 13-3 the magnitude of the effect was rated as significant or higher.

13.3.7.2 Non-Residential Receptors

For receptors other than dwellings, absolute levels rated as medium have been derived from the relevant guidance documents, as described in Appendix 13A. These are given in Table 13-4. The impact on each non-residential receptor has been rated as significant if the absolute noise level is above this threshold and the change in noise level is at least 3 dB(A), i.e. it is rated medium or higher.

Table 13-4: Air Noise Impact Criteria (absolute) – non-residential

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

13.3.8 Significance Criteria – Vibration

Low frequency noise from airborne aircraft has the potential to cause perceptible vibration levels within dwellings. For this reason, the most appropriate noise metric to assess the likelihood of these effects is the maximum C-weighted noise level, denoted L_{Cmax}. C-weighting gives more weight to low frequency noise rather than the more commonly used A-weighting, which approximates the average human hearing response to different frequencies of noise.

This vibration effect is most obviously characterised by effects such as windows rattling. As discussed in the Historic England report (HE, 2014), aircraft passbys that produce a maximum noise level above 97 dB L_{Cmax} are likely to produce an audible rattle of windows. While it is appreciated that low frequency noise from aircraft can induce perceptible vibration levels in lightweight structures and loose-fitting components, the vibration levels are below those at which even minor cosmetic damage would be likely to occur.

Vibration effects due to airborne aircraft can vary depending on the specific details of the building, for example, the room dimensions which can cause resonance effects at certain frequencies. Resonances increase the sound level in parts of the room and decrease it in others which can influence any consequential vibration.

The other potential effect from airborne aircraft vibration is vortex damage to buildings.

Aircraft in flight creates vortices, circulating currents of air that are shed from the aircraft wings. For the most part, these vortices are dissipated by the effects of the wind and atmospheric turbulence before they reach the ground and, whilst they may more often be heard after an aircraft has passed, they seldom have any physical impact at ground level. Occasionally, however, vortices may persist long enough to make contact with buildings underneath the flight path. In extreme cases, the variation in pressure within these vortices can cause some damage to roofs if tiles or slates are not sufficiently firmly secured. In practice, such events may be encountered due to the passage of larger wide-bodied jets which create the largest vortices and during landing when aircraft are relatively close to the ground.

The issue of wake vortex damage was considered in some detail in the 2004 EIS (DA, 2004) that supported the application for the permitted North Runway. The previous EIS was based on an assumption of 348,358 movements per annum, significantly higher than the number now envisaged in 2025 for the proposed change in permitted operations which is 241,000 movements per annum. In granting permission for North Runway under those assumptions, the wake vortex impacts of that number of operations was evidently considered acceptable by the planning authorities. Additionally, the Relevant Action does not affect which aircraft are able to use Dublin Airport. On that basis, the wake vortex impacts associated with the proposed change in permitted operations can be expected similarly to be considered acceptable. There have been no reported cases of wake vortex damage at Dublin.

The noise level of 97 dB L_{Cmax} occurring on average at least once per 24 hour day over the year has been taken as a threshold for potential significance of vibration effects due to airborne aircraft events. Whether a significant effect occurs between scenarios depends on the number of dwellings affected and the frequency of the events.

13.3.9 Consultation

Chapter 5 details the consultation on this application.

13.3.10 Limitations and Assumptions

Planned background noise surveys have been hampered by the Covid-19 pandemic which means that even if measurements were taken at this time, the ambient conditions may not currently be representative. However a detailed survey was carried out in 2016, and is supplemented by the continuous measurements taken by Dublin Airport's fixed Noise Monitoring Terminals (NMTs). In any event, the assessment criteria for air noise are dependent on the absolute levels from the aircraft and not the background noise.

There is always some uncertainty associated with forecasting future aircraft traffic, and this has been increased by the recent Covid-19 pandemic, particularly in the short term. It is currently expected that 32 mppa will be reached in 2025 and this is the scenario assessed.

Some aircraft in the forecasts are either not currently in service or have limited noise data available. Assumptions over the future performance of these types have been made using the data available. This is not expected to significantly affect the assessment as aircraft in this category, such as the Airbus A330neo and Boeing 777X, are a minority of the total aircraft movements.

13.4 Baseline Conditions

This section provides a description of the general noise conditions in the vicinity of Dublin Airport. In view of the location of the airport, the surrounding community is affected primarily by noise from the local road network and airport operations.

The assessment of baseline conditions relates to the long-term situation and considers the noise levels in both 2016 and 2018. Due to the ongoing Covid-19 pandemic the noise conditions at the present time are likely to differ but this effect is expected to be temporary, although the precise timescale is uncertain.

Baseline noise surveys have been carried out at key receptor positions around Dublin Airport to establish the prevailing ambient and background noise conditions during both the daytime and night-time. Use has also been made of the extensive database of noise monitoring data obtained from Dublin Airport's continuous noise monitoring system which records in real time noise from both aircraft and non-aircraft related noise sources continuously throughout 24 hours of each day. This database of measurements has been processed to extract both the total noise levels and just those which correlate with aircraft noise events.

Airborne aircraft noise predictions have been made for 2018 and for the situation once the North Runway is operational in both 2022 and 2025. This chapter also includes an assessment of the noise impact that was expected to occur in the 2025 Consented scenario, which could be interpreted as the intended effects of the conditions.

In order to inform the vibration assessment, airborne aircraft noise predictions using the L_{Cmax} metric have been made for 2018 and for the situation once the North Runway is operational in both 2022 and 2025.

These predictions include both the primary assessment metrics, the results of which are presented later in this section, and the supplementary metrics which are presented in Appendix 13C.