10 Air Quality and Climate

10.1 Introduction

This chapter has been prepared by AWN Consulting Ltd.

This chapter assesses the likely air quality and climate impacts, if any, associated with the proposed residential development on lands at Cornelscourt, Dublin 18. A full description of the development can be found in Chapter 3 of this EIAR.

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10.2 Study Methodology

<u>Relevant Criteria and Background Information</u>

Ambient Air Quality Standards

In order to reduce the risk to health from poor air quality, national and European statutory bodies have set limit values in ambient air for a range of air pollutants. These limit values or "Air Quality Standards" are health or environmental-based levels for which additional factors may be considered. For example, natural background levels, environmental conditions and socio-economic factors may all play a part in the limit value which is set (see Table 10.1 and Appendix 10.1).

Air quality significance criteria are assessed on the basis of compliance with the appropriate standards or limit values. The applicable standards in Ireland include the Air Quality Standards Regulations 2011, which incorporate EU Directive 2008/50/EC, which has set limit values for NO_2, PM_{10}, $PM_{2.5}$, benzene and CO (see Table 10.1). Although the EU Air Quality Limit Values are the basis of legislation, other thresholds outlined by the EU Directives are used which are triggers for particular actions (see Appendix 10.1).

Pollutant	Regulation Note 1	Limit Type	Value
Nitrogen Dioxide	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	200 µg/m^3
		Annual limit for protection of human health	40 µg/m^3
		Critical level for protection of vegetation	30 µg/m^3 NO + NO_2
Particulate Matter (as PM_{10})	2008/50/EC	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 µg/m^3
		Annual limit for protection of human health	40 µg/m^3
Particulate Matter (as $PM_{2.5}$)	2008/50/EC	Annual limit for protection of human health	25 µg/m^3
Benzene	2008/50/EC	Annual limit for protection of human health	5 µg/m^3
Carbon Monoxide	2008/50/EC	8-hour limit (on a rolling basis) for protection of human health	10 mg /m^3 (8.6 ppm)

Table 10.1 - Ambient Air Quality Standards

Dust Deposition Guidelines

The concern from a health perspective is focussed on particles of dust which are less than 10 microns (PM_{10}) and less than 2.5 microns ($PM_{2.5}$) and the EU ambient air quality standards outlined in Table 10.1 have set ambient air quality limit values for PM_{10} and $PM_{2.5}$.

With regards to larger dust particles that can give rise to nuisance dust, there are no statutory guidelines regarding the maximum dust deposition levels that may be generated during the construction phase of a development in Ireland. Furthermore, no specific criteria have been stipulated for nuisance dust in respect of this development.

With regard to dust deposition, the German TA-Luft standard for dust deposition (non-hazardous dust) (German VDI, 2002) sets a maximum permissible emission level for dust deposition of 350 mg/(m^2*day) averaged over a one year period at any receptors outside the site boundary. Recommendations from the Department of the Environment, Health & Local Government (DOEHLG, 2004) apply the Bergerhoff limit value of 350 mg/(m^2*day) to the site boundary of quarries. This limit value can also be implemented with regard to potential dust impacts from construction of the proposed development.

Climate Agreements

Ireland ratified the United Nations Framework Convention on Climate Change (UNFCCC) in April 1994 and the Kyoto Protocol in principle in 1997 and formally in May 2002 (UNFCCC, 1997; UNFCCC, 1999). For the purposes of the EU burden sharing agreement under Article 4 of the Doha Amendment to the Kyoto Protocol, in December 2012, Ireland agreed to limit the net growth of the six Greenhouse Gases (GHGs) under the Kyoto Protocol to 20% below the 2005 level over the period 2013 to 2020 (UNFCCC, 2012).

The UNFCCC is continuing detailed negotiations in relation to GHGs reductions and in relation to technical issues such as Emission Trading and burden sharing. The most recent Conference of the Parties to the Convention (COP24) took place in Katowice, Poland from the 4th to the 14th of December

2018 and focussed on advancing the implementation of the Paris Agreement. The Paris Agreement was established at COP21 in Paris in 2015 and is an important milestone in terms of international climate change agreements. The Paris Agreement was agreed by over 200 nations and has a stated aim of limiting global temperature increases to no more than 2°C above pre-industrial levels with efforts to limit this rise to 1.5°C. The aim is to limit global GHG emissions to 40 gigatonnes as soon as possible whilst acknowledging that peaking of GHG emissions will take longer for developing countries. Contributions to greenhouse gas emissions will be based on Intended Nationally Determined Contributions (INDCs) which will form the foundation for climate action post 2020. Significant progress was also made on elevating adaption onto the same level as action to cut and curb emissions.

The EU, in October 2014, agreed the "2030 Climate and Energy Policy Framework"(EU 2014). The European Council endorsed a binding EU target of at least a 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990. The target will be delivered collectively by the EU in the most cost-effective manner possible, with the reductions in the ETS and non-ETS sectors amounting to 43% and 30% by 2030 compared to 2005, respectively. Secondly, it was agreed that all Member States will participate in this effort, balancing considerations of fairness and solidarity. The policy also outlines, under "Renewables and Energy Efficiency", an EU binding target of at least 27% for the share of renewable energy consumed in the EU in 2030.

Gothenburg Protocol

In 1999, Ireland signed the Gothenburg Protocol to the 1979 UN Convention on Long Range Transboundary Air Pollution. The initial objective of the Protocol was to control and reduce emissions of Sulphur Dioxide (SO_2), Nitrogen Oxides (NO_X), Volatile Organic Compounds (VOCs) and Ammonia (NH_3). To achieve the initial targets Ireland was obliged, by 2010, to meet national emission ceilings of 42 kt for SO_2 (67% below 2001 levels), 65 kt for NO_X (52% reduction), 55 kt for VOCs (37% reduction) and 116 kt for NH_3 (6% reduction). In 2012, the Gothenburg Protocol was revised to include national emission reduction commitments for the main air pollutants to be achieved in 2020 and beyond and to include emission reduction commitments for $PM_{2.5}$.

European Commission Directive 2001/81/EC and the National Emissions Ceiling Directive (NECD), prescribes the same emission limits as the 1999 Gothenburg Protocol. A National Programme for the progressive reduction of emissions of these four transboundary pollutants has been in place since April 2005. The data available from the EPA in 2019 (EPA, 2019) indicated that Ireland complied with the emissions ceilings for SO_2 and NH_3 but failed to comply with the ceiling for NO_X and NMVOCs. Directive (EU) 2016/2284 "*On the Reduction of National Emissions of Certain Atmospheric Pollutants and Amending Directive 2003/35/EC and Repealing Directive 2001/81/EC*" was published in December 2016. The Directive will apply the 2010 NECD limits until 2020 and establish new national emission reduction commitments which will be applicable from 2020 and 2030 for SO_2, NO_X, NMVOC, NH_3, $PM_{2.5}$ and CH_4. In relation to Ireland, 2020 emission targets are 25.5 kt for SO_2 (65% on 2005 levels), 66.9 kt for NO_X (49% reduction on 2005 levels), 56.9 kt for NMVOCs (25% reduction on 2005 levels), 112 kt for NH_3 (1% reduction on 2005 levels) and 15.6 kt for $PM_{2.5}$ (18% reduction on 2005 levels). In relation to 2030, Ireland's emission targets are 10.9 kt (85% below 2005 levels) for SO_2, 40.7 kt (69% reduction) for NO_x, 51.6 kt (32% reduction) for NMVOCs, 107.5 kt (5% reduction) for NH_3 and 11.2 kt (41% reduction) for $PM_{2.5}$.

Local Air Quality Assessment – Impact from Road Traffic (DMRB Assessment)

The air quality assessment has been carried out following procedures described in the publications by the EPA (2002, 2003, 2015, 2017) and using the methodology outlined in the guidance documents published by the UK DEFRA (2018; 2016). The assessment of air quality was carried out using a phased approach as recommended by the UK DEFRA (2018). The phased approach recommends that the complexity of an air quality assessment be consistent with the risk of failing to achieve the air quality standards. In the current assessment, an initial scoping of possible key pollutants was carried out and the likely location of air pollution "hot-spots" identified. An examination of recent EPA and Local Authority data in Ireland (EPA, 2019) has indicated that SO_2, smoke and CO are unlikely to be exceeded in the majority of locations within Ireland and thus these pollutants do not require detailed monitoring or assessment to be carried out. However, the analysis did indicate potential issues in regards to NO_2, PM_{10} and $PM_{2.5}$ at busy junctions in urban centres (EPA, 2019). Benzene, although previously reported at quite high levels in urban centres, has recently been measured at several city centre locations to be well below the EU limit value (EPA, 2018). Historically, CO levels in urban areas were a cause for concern. However, CO concentrations have decreased significantly over the past number of years and are now measured to be well below the limits even in urban centres (EPA 2018; 2019). The key pollutants reviewed in the assessments are NO_2, PM_{10}, $PM_{2.5}$, benzene and CO, with particular focus on NO_2 and PM_{10}.

Key pollutant concentrations will be predicted for nearby sensitive receptors for the following scenarios:

- The Existing Scenario, for model verification;
- Opening Year Do-Nothing Scenario (DN), which assumes the retention of present site usage with no development in place;
- Opening Year Do-Something Scenario (DS), which assumes the proposed development is in place;
- Design Year Do-Nothing Scenario (DN), which assumes no development is in place; and
- Design Year of the Do-Something Scenario (DS), which assumes the proposed development is in place.

The assessment methodology involved air dispersion modelling using the UK DMRB Screening Model (Version 1.03c, July 2007), the NO_x to NO_2 Conversion Spreadsheet (Version 7.1, April 2019) (UK DEFRA, 2019), and following guidance issued by the TII (2011), UK Highways Agency (2007), UK DEFRA (2018; 2016; UK DETR 1998) and the EPA (2002; 2003; 2015; 2017).

The TII guidance (2011) states that the assessment must progress to detailed modelling if:

- Concentrations exceed 90% of the air quality limit values when assessed by the screening method; or
- Sensitive receptors exist within 50m of a complex road layout (e.g. grade separated junctions, hills etc).

The UK DMRB guidance (UK Highways Agency, 2007), on which the TII guidance was based, states that road links meeting one or more of the following criteria can be defined as being 'affected' by a proposed development and should be included in the local air quality assessment:

- Road alignment change of 5 metres or more;
- Daily traffic flow changes by 1,000 AADT or more;
- HDV flows change by 200 vehicles per day or more;
- Daily average speed changes by 10 km/h or more; or
- Peak hour speed changes by 20 km/h or more.

Concentrations of key pollutants are calculated at sensitive receptors that have the potential to be affected by the proposed development. For road links which are deemed to be affected by the proposed development and within 200 m of the chosen sensitive receptors inputs to the air dispersion model consist of: road layouts, receptor locations, annual average daily traffic movements (AADT), percentage of heavy goods vehicles, annual average traffic speeds and background concentrations. The UK DMRB guidance states that road links at a distance of greater than 200 m from a sensitive receptor will not influence pollutant concentrations at the receptor.

Using the input data the model predicts the road traffic contribution to ambient ground level concentrations at the worst-case sensitive receptors using generic meteorological data. The DMRB model uses conservative emission factors, the formulae for which are outlined in the DMRB Volume 11 Section 3 Part 1 – HA 207/07 Annexes B3 and B4. These worst-case road contributions are then added to the existing background concentrations to give the worst-case predicted ambient concentrations.

The worst-case predicted ambient concentrations are then compared with the relevant ambient air quality standards to assess the compliance of the proposed development with those standards.

The TII Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes (2011) detail a methodology for determining air quality impact significance criteria for road schemes, which can be applied to any project that causes a change in traffic flows. The degree of impact is determined based on both the absolute and relative impact of the proposed development. The TII significance criteria have been adopted for the proposed development and are detailed in Appendix 10.2, Table A10.1 to Table A10.3. The significance criteria are based on PM_{10} and NO_2 as these pollutants are most likely to exceed the annual mean limit values (40 µg/m^3). However, the criteria have also been applied to the predicted 8-hour CO, annual benzene and annual $PM_{2.5}$ concentrations for the purposes of this assessment.

There is the potential for a number of emissions to the atmosphere during the operational phase of the development. In particular, the traffic-related air emissions may generate quantities of air pollutants such as NO_2, CO, benzene, PM_{10} and $PM_{2.5}$. Cumulative effects have been assessed, as recommended in the EU Directive on EIA (Council Directive 97/11/EC) and using the methodology of the UK DEFRA (2018, 2016). Firstly, background concentrations (EPA 2019) have been included in the modelling study. These background concentrations are year-specific and account for non-localised sources of the pollutants of concern (EPA 2018). Appropriate background levels were selected based on the available monitoring data provided by the EPA (EPA 2018) (see Section 10.3). Traffic flow information was obtained from the traffic consultant for this project and has been used to model pollutant levels under various traffic scenarios and under sufficient spatial resolution to assess whether any significant air quality impact on sensitive receptors may occur.

The impact of the proposed development has been assessed by modelling emissions from the traffic generated as a result of the development. The impact of emissions of CO, benzene, NO_2, PM_{10} and $PM_{2.5}$ for the baseline, opening and design years was predicted at the nearest sensitive receptors to the development. This assessment allows the significance of the development, with respect to both relative and absolute impact, to be determined.

The receptors modelled represent the worst-case locations close to the proposed development and were chosen due to their close proximity (within 200 m) to the road links impacted by proposed development. The projected traffic data used for the local air quality assessment is shown in Table 10.2, with the percentage of HGVs shown in parenthesis below the AADT. Three sensitive residential receptors (R1 – R3) in the vicinity of the proposed development have been assessed. Sensitive receptors have been chosen as they have the potential to be adversely impacted by the development, these receptors are detailed in Figure 10.1.

Road Name	Base Year	Do-Nothing		Do-Something		Speed (kph)
	2019	2021	2036	2021	2036	
	AADT (% HGV)	AADT (% HGV)	AADT (% HGV)	AADT (% HGV)	AADT (% HGV)	
Bray Road (Northwest of site entrance) - Link F	8,805 (2%)	9,042 (2%)	10,428 (2%)	9,742 (2%)	11,128 (2%)	50
Bray Road - (Southeast of site entrance) Link H	9,121 (7%)	9,367 (7%)	10,803 (7%)	9,936 (7%)	11,371 (7%)	50
Bray Road (Northwest of Cornelscourt Hill Road) - Link I	9,055 (7%)	9,299 (7%)	10,724 (7%)	9,874 (7%)	11,299 (7%)	50
Cornelscourt Hill Road - Link J	9,459 (11%)	9,714 (11%)	11,202 (11%)	9,802 (11%)	11,291 (11%)	50
Mart Lane - Link E	2,297 (4%)	2,359 (4%)	2,720 (4%)	2,403 (4%)	2,764 (4%)	30

Table 10.2 -Traffic Data used in the Air Modelling Assessment

Figure 10.1 - Worst-case Air Sensitive Receptors used in the Air Modelling Assessment

Update to NO2 Projections using DMRB

In 2011 the UK DEFRA published research on the long-term trends in NO_2 and NO_X for roadside monitoring sites in the UK. This study marked a decrease in NO_2 concentrations between 1996 and 2002, after which the concentrations stabilised with little reduction between 2004 and 2010. The result of this is that there now exists a gap between projected NO_2 concentrations which UK DEFRA previously published and monitored concentrations. The impact of this 'gap' is that the DMRB screening model can under-predict NO_2 concentrations for predicted future years. Subsequently, the UK Highways Agency (HA) published an Interim advice note (IAN 170/12) in order to correct the DMRB results for future years.

Conversion of NO_x to NO_2

NO_x ($NO + NO_2$) is emitted by vehicles exhausts. The majority of emissions are in the form of NO, however, with greater diesel vehicles and some regenerative particle traps on HGVs the proportion of NO_x emitted as NO_2, rather than NO is increasing. With the correct conditions (presence of sunlight and O_3) emissions in the form of NO, have the potential to be converted to NO_2.

Transport Infrastructure Ireland states the recommended method for the conversion of NO_x to NO_2 in "Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes"(2011). The TII guidelines recommend the use of DEFRAs NO_x to NO_2 calculator (2019) which was originally published in 2009 and is currently on version 7.1. This calculator (which can be downloaded in the form of an excel spreadsheet) accounts for the predicted availability of O_3 and proportion of NO_x emitted as NO for each local authority across the UK. O_3 is a regional pollutant and therefore concentrations do not vary in the same way as concentrations of NO_2 or PM_{10}.

The calculator includes Local Authorities in Northern Ireland and the TII guidance recommends the use of 'Armagh, Banbridge and Craigavon' as the choice for local authority when using the calculator. The choice of Craigavon provides the most suitable relationship between NO_2 and NO_x for Ireland. The "All other urban UK traffic" traffic mix option was used.

Regional Impact Assessment (Including Climate)

The impact of the proposed development at a national / international level has been determined using the procedures given by Transport Infrastructure Ireland (2011) and the methodology provided in Annex 2 in the UK Design Manual for Roads and Bridges (2016). The assessment focused on determining the resulting change in emissions of volatile organic compounds (VOCs), nitrogen oxides (NO_x) and carbon dioxide (CO_2) associated with the proposed development. The Annex provides a method for the prediction of the regional impact of emissions of these pollutants from road schemes and can be applied to any development that results in a change in traffic volumes. The inputs to the air dispersion model consist of information on road link lengths, AADT movements and annual average traffic speeds.

Ecological Assessment

For routes that pass within 2 km of a designated area of conservation (either Irish or European designation) the TII requires consultation with an Ecologist (2011). However, in practice the potential for impact to an ecological site is highest within 200 m of the proposed scheme and when significant changes in AADT (>5%) occur.

Transport Infrastructure Ireland's Guidelines for Assessment of Ecological Impacts of National Road Schemes (2009) and Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities (DEHLG, 2010) provide details regarding the legal protection of designated conservation areas.

If both of the following assessment criteria are met, an assessment of the potential for impact due to nitrogen deposition shall be conducted:

- A designated area of conservation is located within 200 m of the proposed development; and
- A significant change in AADT flows (>5%) will occur.

There are no designated areas of conservation within 200m of the proposed site boundary or the roads impacted by the development, therefore, no further assessment of the impact with regard to nitrogen oxide (NO_x) concentrations and nitrogen deposition is required.

10.3 The Existing Receiving Environment (Baseline)

Meteorological Data

A key factor in assessing temporal and spatial variations in air quality is the prevailing meteorological conditions. Depending on wind speed and direction, individual receptors may experience very significant variations in pollutant levels under the same source strength (i.e. traffic levels). Wind is of key importance in dispersing air pollutants and for ground level sources, such as traffic emissions, pollutant concentrations are generally inversely related to wind speed. Thus, concentrations of pollutants derived from traffic sources will generally be greatest under very calm conditions and low wind speeds when the movement of air is restricted. In relation to PM_{10}, the situation is more complex due to the range of sources of this pollutant. Smaller particles (less than $PM_{2.5}$) from traffic sources will be dispersed more rapidly at higher wind speeds. However, fugitive emissions of coarse particles ($PM_{2.5}$ - PM_{10}) will actually increase at higher wind speeds. Thus, measured levels of PM_{10} will be a non-linear function of wind speed.

The most representative weather station collating detailed weather records is Dublin Airport Meteorological Station which is located approximately 18 km north to northwest of the site. For data collated during five representative years (2014 - 2018), the predominant wind direction is westerly to south-westerly, with generally moderate wind speeds (see Figure 10.2).

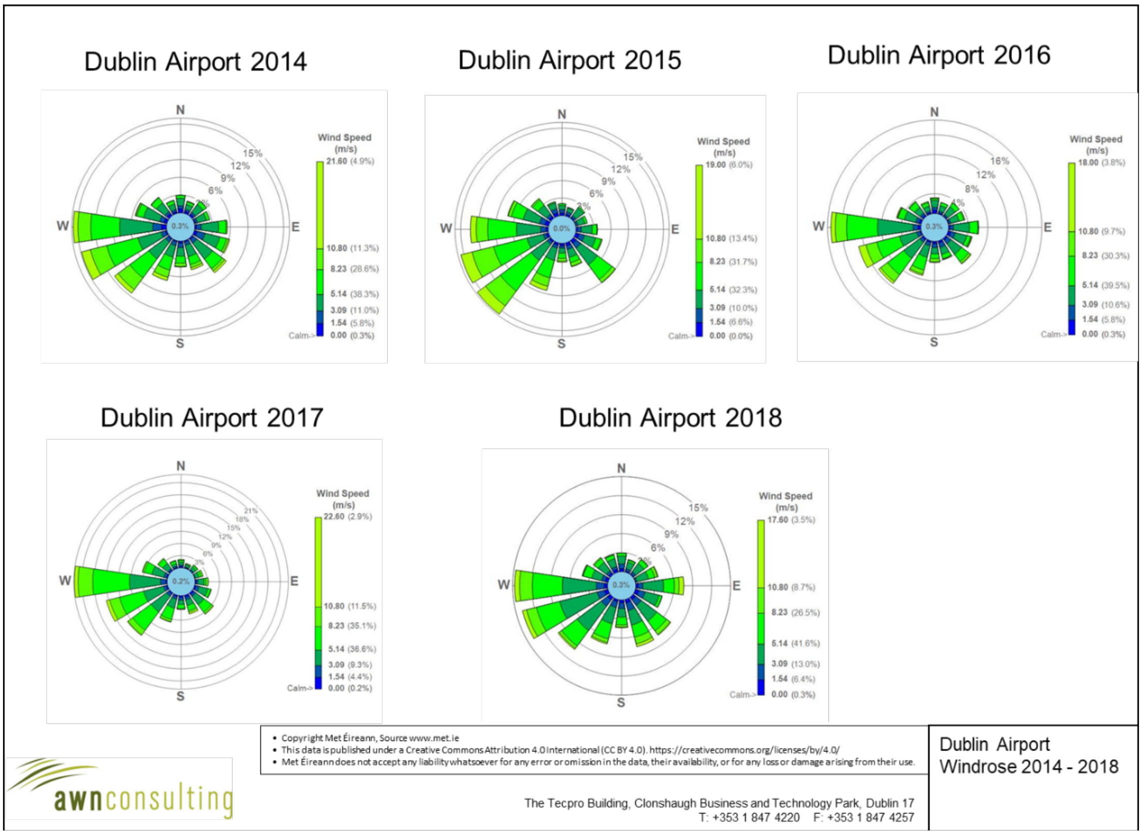

Figure 10.2 - Dublin Airport Windrose 2014 - 2018

Trends in Air Quality

Air quality is variable and subject to both significant spatial and temporal variation. In relation to spatial variations in air quality, concentrations generally fall significantly with distance from major road sources (WHO, 2006). Thus, residential exposure is determined by the location of sensitive receptors relative to major roads sources in the area. Temporally, air quality can vary significantly by orders of magnitude due to changes in traffic volumes, meteorological conditions and wind direction.

In assessing baseline air quality, two tools are generally used: ambient air monitoring and air dispersion modelling. In order to adequately characterise the current baseline environment through monitoring, comprehensive measurements would be required at a number of key receptors for PM_{10}, NO_2 and benzene. In addition, two of the key pollutants identified in the scoping study (PM_{10} and NO_2) have limit values which require assessment over time periods varying from one hour to one year.

Thus, continuous monitoring over at least a one-year period at a number of locations would be necessary in order to fully determine compliance for these pollutants. Although this study would provide information on current air quality it would not be able to provide predictive information on baseline conditions (UK DETR, 1998), which are the conditions which prevail just prior to opening in the absence of the development. Hence the impacts of the development were fully assessed by air dispersion modelling (UK DETR, 1998) which is the most practical tool for this purpose. The baseline environment has also been assessed using modelling, since the use of the same predictive technique for both the 'do-nothing' and 'do-something' scenario will minimise errors and allow an accurate determination of the relative impact of the development.

Baseline Air Quality – Review of Available Background Data

Air quality monitoring programs have been undertaken in recent years by the EPA and Local Authorities. The most recent annual report on air quality in Ireland is "Air Quality In Ireland 2017 – Indicators of Air Quality" (EPA, 2018). The EPA website details the range and scope of monitoring undertaken throughout Ireland and provides both monitoring data and the results of previous air quality assessments (EPA, 2019).

As part of the implementation of the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002), four air quality zones have been defined in Ireland for air quality management and assessment purposes (EPA, 2018). Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 23 towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000, is defined as Zone D.

In terms of air monitoring and assessment, the proposed development site is within Zone A (EPA, 2018). The long-term EPA monitoring data has been used to determine background concentrations for the key pollutants in the region of the proposed development. The background concentration accounts for all non-traffic derived emissions (e.g. natural sources, industry, home heating etc.).

With regard to NO_2, continuous monitoring data from the EPA (EPA, 2018), at suburban (non-roadside) Zone A locations show that current levels of NO_2 are below both the annual and 1-hour limit values, with annual average levels ranging from 14 – 17 μg/m^3 in 2017 (see Table 10.3). Sufficient data is available for the stations in Ballyfermot, Dun Laoghaire and Swords to observe the long-term trend since 2013 (EPA, 2018) (see Table 10.3), with results ranging from 13 – 19 μg/m^3 and few exceedances of the one-hour limit value and with an average annual mean for Dun Laoghaire for this period (2013 - 2017) of 17 μg/m^3. Based on these results, a conservative estimate of the background NO_2 concentration in the region of the proposed development is 18 μg/m^3.

Station	Averaging Period	Year				
		2013	2014	2015	2016	2017
Rathmines	Annual Mean NO_2 (μg/m^3)	19	17	18	20	17
	99.8th%ile 1-hr NO_2 (μg/m^3)	92	105	105	88	86
Ballyfermot	Annual Mean NO_2 (μg/m^3)	16	16	16	17	17
	99.8th%ile 1-hr NO_2 (μg/m^3)	82	93	127	90	112
Dun Laoghaire	Annual Mean NO_2 (μg/m^3)	16	15	16	19	17
	99.8th%ile 1-hr NO_2 (μg/m^3)	92	86	91	105	101
Swords	Annual Mean NO_2 (μg/m^3)	15	14	13	16	14
	99.8th%ile 1-hr NO_2 (μg/m^3)	87	137	93	96	79

Table 10.3 - Trends In Zone A Air Quality - Nitrogen Dioxide (NO_2)

Note 1 Annual average limit value - 40 μg/m^3 (EU Council Directive 2008/50/EC & S.I. No. 180 of 2011).

Note 2 1-hour limit value - 200 μg/m^3 as a 99.8th%ile, i.e. not to be exceeded >18 times per year (EU Council Directive 2008/50/EC & S.I. No. 180 of 2011).

Continuous PM_{10} monitoring carried out at the locations of Ballyfermot, Tallaght, Phoenix Park, Dún Laoghaire and Rathmines showed 2013 - 2017 annual mean concentrations ranging from 9 - 17 μg/m^3 (Table 10.4), with at most 8 exceedances (in Rathmines) of the 24-hour limit value of 50 μg/m^3 (35 exceedances are permitted per year). The most representative location is Dún Laoghaire which has an average annual mean concentrations of 14 μg/m^3 over the five year period. Based on the EPA data (Table 10.4) a conservative estimate of the current background PM_{10} concentration in the region of the proposed development is 15 μg/m^3.

Station	Averaging Period	Year				
		2013	2014	2015	2016	2017
Ballyfermot	Annual Mean PM_{10} (μg/m^3)	12	11	12	11	12
	24-hr Mean > 50 μg/m^3 (days)	2	2	3	0	1
Dún Laoghaire	Annual Mean PM_{10} (μg/m^3)	17	14	13	13	12
	24-hr Mean > 50 μg/m^3 (days)	5	2	3	0	2
Tallaght	Annual Mean PM_{10} (μg/m^3)	17	15	14	14	12
	24-hr Mean > 50 μg/m^3 (days)	5	2	4	0	2
Rathmines	Annual Mean PM_{10} (μg/m^3)	17	14	15	15	13
	24-hr Mean > 50 μg/m^3 (days)	8	3	5	3	5
Phoenix Park	Annual Mean PM_{10} (μg/m^3)	14	12	12	11	9
	24-hr Mean > 50 μg/m^3 (days)	3	0	2	0	1

Table 10.4 - Trends In Zone A Air Quality – PM_{10}

Continuous $PM_{2.5}$ monitoring carried out at the Zone A location of Rathmines showed $PM_{2.5}/PM_{10}$ ratios ranging from 0.63 – 0.68 over the period 2013 - 2017. Based on this information, a conservative ratio of 0.7 was used to generate a background $PM_{2.5}$ concentration in the region of the proposed development of 10.5 μg/m^3.

In terms of benzene, the annual mean concentration in the Zone A monitoring location of Rathmines ranged from 0.92 – 1.0 μg/m^3 for the period 2013 – 2017. An upper average annual mean concentration of 0.95 μg/m^3 was observed for this period. This is well below the limit value of 5 μg/m^3. Based on this EPA data a conservative estimate of the background benzene concentration in the vicinity of the proposed development is 1.0 μg/m^3.

With regard to CO, annual averages at the Zone A, locations of Winetavern Street and Coleraine Street over the 2013 – 2017 period are low, peaking at 5% of the limit value (10 mg/m^3). Based on this EPA data, a conservative estimate of the background CO concentration in the region of the development is 0.5 mg/m^3.

Background concentrations for the opening and design years have been calculated using the current background concentrations and the year on year reduction factors provided by Transport Infrastructure Ireland in the Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes and the UK Department for Environment, Food and Rural Affairs LAQM.TG (UK DEFRA 2018).

10.4 Characteristics of the Proposed Development

The current proposal provides for a Build to Rent development consisting:

- 468 residential units (452 apartments and 16 houses) as follow:
    - 41 no. studio apartment units,
    - 257 no. 1 bed apartment units,

  - 136 no. 2 bed apartment units;
  - 18 no. 3 bed apartment units;
  - 10 no. 3 bed semi-detached house units; and
  - 6 no. 1 bed bungalow units.
- A café / restaurant of c. 140 sq m; office space of 149 sq m; concierge of c. 149 sq m; and a residential tenant amenity space of c. 458 sq m is also proposed.
- 274 Car Parking Spaces (273 at basement level and 1 at ground level)
- 12 Motor Cycle Spces
- 616 Bicycle Parking Spaces
- Public Open Space
- Vehicular Access
- Basement Areas
- Sub Stations and 3 Switch Rooms
- All Associated Site Development Works

The proposed development is described in Chapter 2. When considering a development of this nature, the potential air quality and climate impact on the surroundings must be considered for each of two distinct stages:

- construction phase, and;
- operational phase.

During the construction stage the main focus in relation to air quality impacts will be from potential fugitive dust emissions from site activities. Emissions from construction vehicles and machinery have the potential to impact climate. The construction phase impacts will be short-term in duration.

The primary potential sources of air and climatic emissions during the operational phase of the proposed development are deemed long-term and will involve a change in traffic flows on road links nearby the proposed development.

10.5 Potential Impact of the Proposed Development

Construction Phase

Air Quality

Construction dust has the potential to cause local impacts through dust nuisance at the nearest houses. Construction activities such as excavation, earth moving and backfilling may generate quantities of dust, particularly in dry and windy weather conditions. While dust from construction activities tends to be deposited within 200m of a construction site, the majority of the deposition occurs within the first 50m (as shown in Table 10.5). The extent of any dust generation depends on the nature of the dust (soils, peat, sands, gravels, silts etc.) and the nature of the construction activity. In addition, the potential for dust dispersion and deposition depends on local meteorological factors such as rainfall, wind speed and wind direction. Vehicles transporting material to and from the site also have the potential to cause dust generation along the selected haul routes from the construction areas.

Source		Potential Distance for Significant Effects (Distance From Source)		
Scale	**Description**	**Soiling**	**PM_{10}**	**Vegetation Effects**
Major	Large construction sites, with high use of haul roads	100m	25m	25m
Moderate	Moderate sized construction sites, with moderate use of haul roads	50m	15m	15m
Minor	Minor construction sites, with limited use of haul roads	25m	10m	10m

Table 10.5 - Assessment Criteria for the Impact of Dust from Construction, with Standard Mitigation in Place (TII, 2011)

<u>**Operational Phase**</u>

Air Quality

There is the potential for a number of emissions to the atmosphere during the operational phase of the development. In particular, the traffic-related air emissions may generate quantities of air pollutants such as NO_2, CO, benzene and PM_{10}.

Climate

There is the potential for a number of greenhouse gas emissions to atmosphere during the operational phase of the development. Road traffic and space heating of buildings may give rise to CO_2 and N_2O emissions. There is the potential for a number of greenhouse gas emissions to atmosphere during the operational phase of the development. However, due to the size of the development the impact of the proposed development on national greenhouse gas emissions is predicted to be insignificant in terms of Ireland's obligations under the EU 2020 target.

10.6 Potential Cumulative Impacts

<u>**Construction Phase**</u>

Air Quality

As with the proposed development, the primary source of air quality impacts during the construction phase of nearby committed developments will be the potential for nuisance dust impacts. The dust minimisation measures outlined for the proposed development should be implemented throughout the construction phase for all developments in the vicinity of the site to avoid any nuisance dust impacts occurring. Once these minimisation measures are in place the impact to air quality is considered short-term and not significant.

Climate

Construction machinery and vehicles have the potential to impact climate through the release of GHG emissions. However, based on the nature and scale of the proposed works, the impact to climate is considered imperceptible due to the low volumes of machinery and vehicles required for the construction of the proposed development as well as the construction phase of nearby committed developments.

Human Health

The mitigation measures that will be put in place during construction of the proposed development should be implemented throughout the construction phase for all developments in the vicinity of the site to ensure that the impact of the developments complies with all EU ambient air quality legislative limit values which are based on the protection of human health. Therefore, the cumulative impact of construction of the proposed development with nearby developments is likely to be short-term and imperceptible with respect to human health.

Operational Phase

The local air quality impact assessment, regional air quality impact assessment and climate impact assessment described in section 10.10 have all been based on cumulative traffic data incorporating projected traffic from existing and committed developments in the vicinity of the project site. As the outcomes of those assessments concluded that impacts will be long-term and imperceptible with respect to air quality and climate, no further cumulative impact assessment is required for the proposed development.

10.7 Do Nothing Scenario

The "Do Nothing" scenario includes retention of the current site without the proposed residential development in place. In this scenario, ambient air quality at the site will remain as per the baseline and will change in accordance with trends within the wider area (including influences from potential new developments in the surrounding area, changes in road traffic, etc). The "Do Nothing" scenario is modelled within the local air quality impact assessment, regional air quality impact assessment and climate impact assessment (see section 10.10) based on projected traffic data for local road links assuming the proposed development is not in place in future years.

10.8 Risks to Human Health

Best practice mitigation measures are proposed for the construction phase of the proposed development which will focus on the pro-active control of dust and other air pollutants to minimise generation of emissions at source. The mitigation measures that will be put in place during construction of the proposed development will ensure that the impact of the development complies with all EU ambient air quality legislative limit values which are based on the protection of human health. Therefore, the air quality impact of construction of the proposed development will be short-term and imperceptible with respect to human health.

Air dispersion modelling of operational traffic emissions was undertaken to assess the impact of the development with reference to EU ambient air quality standards which are based on the protection of human health. As demonstrated by the modelling results (see section 10.10) emissions as a result of the proposed development are compliant with all National and EU ambient air quality limit values and, therefore, the impact on human health will be long-term and imperceptible.

10.9 Mitigation Measures

Construction Phase

Air Quality

The pro-active control of fugitive dust will ensure the prevention of significant emissions, rather than an inefficient attempt to control them once they have been released. The main contractor will be responsible for the coordination, implementation and ongoing monitoring of the dust management plan. The key aspects of controlling dust are listed below. Full details of the dust management plan can be found in Appendix 10.3.

- The specification and circulation of a dust management plan for the site and the identification of persons responsible for managing dust control and any potential issues;
- The development of a documented system for managing site practices with regard to dust control;
- The development of a means by which the performance of the dust management plan can be monitored and assessed;
- The specification of effective measures to deal with any complaints received.

At all times, the procedures within the plan will be strictly monitored and assessed. In the event of dust nuisance occurring outside the site boundary, movements of materials likely to raise dust would be curtailed and satisfactory procedures implemented to rectify the problem before the resumption of construction operations.

Climate

Construction traffic and embodied energy of construction materials are expected to be the dominant source of greenhouse gas emissions as a result of the construction phase of the proposed development. Construction vehicles, generators etc., may give rise to some CO_2 and N_2O emissions. However, based on the short-term nature and relatively small scale of the works, the impact on climate will be imperceptible.

Nevertheless, some site-specific mitigation measures can be implemented during the construction phase of the proposed development to ensure emissions are minimised. In particular the prevention of on-site or delivery vehicles from leaving engines idling, even over short periods. Minimising waste of materials due to poor timing or over ordering on site will aid to minimise the embodied carbon footprint of the site.

Operational Phase

No additional mitigation measures are required during the operational phase of the proposed development as it is predicted to have an imperceptible impact on ambient air quality and climate.

10.10 Predicted Impacts of the Proposed Development

Construction Phase

Air Quality

The greatest potential impact on air quality during the construction phase of the proposed development is from construction dust emissions and the potential for nuisance dust and $PM_{10}/PM_{2.5}$ emissions. The proposed development can be considered moderate in scale and therefore there is the potential for significant dust soiling 50m from the source (TII 2011) (Table 10.5). While construction dust tends to be deposited within 200m of a construction site, the majority of the deposition occurs within the first 50m. There are a number of sensitive receptors, predominantly residential properties in close proximity to the site. In order to minimise dust emissions during construction, a series of mitigation measures have been prepared in the form of a dust minimisation plan. Provided the dust minimisation measures outlined in the plan (see Appendix 10.3) are adhered to, the air quality impacts during the construction phase will be short-term and not significant.

Climate

There is the potential for a number of greenhouse gas emissions to atmosphere during the construction of the development. Construction vehicles, generators etc., may give rise to CO_2 and N_2O emissions. However, based on the scale and nature of the works and the duration of construction, the impact of the construction phase on climate is considered to be short-term and imperceptible.

Operational Phase

Local Air Quality

Transport Infrastructure Ireland Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes (TII, 2011) detail a methodology for determining air quality impact significance criteria for road schemes and has been adopted for this assessment, as is best practice. The degree of impact is determined based on both the absolute and relative impact of the proposed development. Results are compared against the 'Do-Nothing' scenario, which assumes that the proposed development is not in place in future years, in order to determine the degree of impact.

NO_2

The results of the assessment of the impact of the proposed development on NO_2 in the opening year 2021 are shown in Table 10.6 for the Highways Agency IAN 170/12 and Table 10.7 using the UK

Department for Environment, Food and Rural Affairs technique, respectively. The annual average concentration is within the limit value at all worst-case receptors using both techniques. Levels of NO_2 are 62% of the annual limit value in 2021 using the more conservative IAN technique, while concentrations are 60% of the annual limit value in 2021 using the UK Department for Environment, Food and Rural Affairs technique. The hourly limit value for NO_2 is 200 $\mu g/m^3$ and is expressed as a 99.8^{th} percentile (i.e. it must not be exceeded more than 18 times per year). The maximum 1-hour NO_2 concentration is not predicted to be exceeded using either technique (see Table 10.8).

The results of the assessment of the impact of the proposed development on NO_2 in the design year 2036 are shown in Table 10.6 for the Highways Agency IAN 170/12 and Table 10.7 using the UK Department for Environment, Food and Rural Affairs technique, respectively. The annual average concentration is within the limit value at all worst-case receptors using both techniques. Levels of NO_2 are 61% of the annual limit value in 2036 using the more conservative IAN technique, while concentrations are 53% of the annual limit value in 2036 using the UK Department for Environment, Food and Rural Affairs technique. The hourly limit value for NO_2 is 200 $\mu g/m^3$ and is expressed as a 99.8^{th} percentile (i.e. it must not be exceeded more than 18 times per year). The maximum 1-hour NO_2 concentration is not predicted to be exceeded using either technique (see Table 10.8).

The impact of the proposed development on annual mean NO_2 levels can be assessed relative to "Do Nothing (DN)" levels in 2021 and 2036. Relative to baseline levels, some imperceptible increases in pollutant levels are predicted as a result of the proposed development. With regard to impacts at individual receptors, the greatest impact on NO_2 concentrations will be an increase of 0.6% of the annual limit value at Receptor 3. Thus, using the assessment criteria outlined in Appendix 10.2 Tables A10.1 – A10.2, the impact of the proposed development in terms of NO_2 is negligible. Therefore, the overall impact of NO_2 concentrations as a result of the proposed development is long-term and imperceptible at all of the receptors assessed.

<u>PM_{10}</u>

The results of the modelled impact of the proposed development for PM_{10} in the opening year 2021 are shown in Table 10.9. Predicted annual average concentrations at the worst-case receptor in the region of the development are at most 40% of the limit value in 2021. It is predicted that the worst case receptors will not experience any exceedances of the 50 $\mu g/m^3$ 24-hour mean limit value with or without the proposed development in place (35 exceedances are permitted per year) (see Table 10.10).

The results of the modelled impact of the proposed development for PM_{10} in the design year 2036 are shown in Table 10.9. Predicted annual average concentrations at the worst-case receptor in the region of the development are at most 41% of the limit value in 2036. It is predicted that the worst case receptors will not experience any exceedances of the 50 $\mu g/m^3$ 24-hour mean limit value with or without the proposed development in place (35 exceedances are permitted per year) (see Table 10.10).

Relative to baseline levels, some imperceptible increases in PM_{10} levels at the worst-case receptors are predicted as a result of the proposed development. The greatest impact on PM_{10} concentrations in the region of the proposed development will be an increase of 0.12% of the annual limit value at Receptor 1. Thus, the magnitude of the changes in air quality are negligible at all receptors based on the criteria outlined in Appendix 10.2, Tables A10.1 – A10.3. Therefore, the overall impact of PM_{10} concentrations as a result of the proposed development is long-term and imperceptible.

<u>$PM_{2.5}$</u>

The results of the modelled impact of the proposed development for $PM_{2.5}$ are shown in Table 10.11. Predicted annual average concentrations in the region of the proposed development are 45% of the limit value in 2021 and 46% of the limit value in 2036 at the worst-case receptor.

Relative to baseline levels, imperceptible increases in $PM_{2.5}$ levels at the worst-case receptors are predicted as a result of the proposed development. None of the receptors assessed will experience an increase in concentrations of over 0.13% of the limit value. Therefore, using the assessment criteria outlined in Appendix 10.2, Tables A10.1 – A10.2, the impact of the proposed development with regard to $PM_{2.5}$ is negligible at all of the receptors assessed. Overall, the impact of increased $PM_{2.5}$ concentrations as a result of the proposed development is long-term and imperceptible.

CO and Benzene

The results of the modelled impact of CO and benzene are shown in Table 10.12 and Table 10.13, respectively. Predicted pollutant concentrations with the proposed development in place are below the ambient standards at all locations. Levels of benzene are 22% of the limit value in 2021 and 2036 with levels of CO reaching 29% of the limit value in 2021 and 2036.

Relative to baseline levels, some imperceptible increases in pollutant levels at the worst-case receptors are predicted as a result of the proposed development. The greatest impact on CO and benzene concentrations will be an increase of 0.15% of the CO limit and 0.07% of the Benzene limit value at Receptor 1. Thus, using the assessment criteria for NO_2 and PM_{10} outlined in Appendix 10.2 and applying these criteria to CO and benzene, the impact of the proposed development in terms of CO and benzene is long-term and imperceptible.

Summary of Local Air Quality Modelling Assessment

Levels of traffic-derived air pollutants from the proposed development will not exceed the ambient air quality standards either with or without the proposed development in place. Using the assessment criteria outlined in Appendix 10.2, Table A10.1 – A10.3, the impact of the proposed development in terms of PM_{10}, $PM_{2.5}$, CO, NO_2 and benzene is long-term, localised and imperceptible.

Regional Air Quality Impact

The regional impact of the proposed development on emissions of NO_X and VOCs has been assessed using the procedures of Transport Infrastructure Ireland (TII 2011) and the UK Department for Environment, Food and Rural Affairs (2018). The results (see Table 10.14) show that the likely impact of the proposed development on Ireland's obligations under the Targets set out by Directive EU 2016/2284 "On the reduction of national emissions of certain atmospheric pollutants and amending Directive 2003/35/EC" are imperceptible and long-term. For the opening year 2021, the predicted impact of the changes in AADT is to increase NO_x levels by 0.0001% of the NO_x emissions ceiling and increase VOC levels by 0.00002% of the VOC emissions ceiling to be complied with in 2020. For the design year 2036, the predicted impact of the changes in AADT is to increase NO_x levels by 0.0001% of the NO_x emissions ceiling and increase VOC levels by 0.00003% of the VOC emissions ceiling to be complied with in 2030.

Therefore, the impacts on regional air quality during the operational stage of the proposed development are predicted to be long-term and imperceptible.

Climate

The impact of the proposed development on emissions of CO_2 impacting climate were also assessed using the Design Manual for Roads and Bridges screening model (see Table 10.14). The results show that the impact of the proposed development will be to increase CO_2 emissions by 0.0001% of Ireland's EU Target in the opening year of 2021 and in the design year of 2036. Thus, the impact of the proposed development on national greenhouse gas emissions will be insignificant in terms of Ireland's obligations under the EU 2020 Target (EU, 2017).

Therefore, the impacts on climate during the operational stage of the proposed development are predicted to be long-term and imperceptible.

Receptor	Impact Opening Year 2021					Impact Design Year 2036				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	20.8	21.1	0.22	Imperceptible	Negligible Increase	20.0	20.2	0.23	Imperceptible	Negligible Increase
2	21.8	22.0	0.23	Imperceptible	Negligible Increase	21.1	21.3	0.24	Imperceptible	Negligible Increase
3	24.5	24.8	0.24	Imperceptible	Negligible Increase	24.0	24.2	0.25	Imperceptible	Negligible Increase

Table 10.6 - Annual Mean NO_2 Concentrations (µg/m^3) (using Interim advice note 170/12 V3 Long Term NO_2 Trend Projections)

Receptor	Impact Opening Year 2021					Impact Design Year 2036				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	20.0	20.2	0.21	Imperceptible	Negligible Increase	17.1	17.3	0.20	Imperceptible	Negligible Increase
2	21.0	21.2	0.22	Imperceptible	Negligible Increase	18.1	18.3	0.21	Imperceptible	Negligible Increase
3	23.7	23.9	0.23	Imperceptible	Negligible Increase	21.0	21.3	0.22	Imperceptible	Negligible Increase

Table 10.7 - Annual Mean NO_2 Concentrations (µg/m^3) (using UK Department for Environment, Food and Rural Affairs Technical Guidance)

Receptor	IAN 170/12 V3 Long Term NO2 Trend Projections Technique				Defra's Technical Guidance Technique			
	Opening Year 2021		Design Year 2036		Opening Year 2021		Design Year 2036	
	DN	DS	DN	DS	DN	DS	DN	DS
1	73	73.7	70	70.8	70.1	70.8	59.8	60.5
2	76.4	77.2	73.7	74.6	73.4	74.2	63.4	64.1
3	85.9	86.7	84	84.8	82.8	83.6	73.6	74.4

Table 10.8 - 99.8th percentile of daily maximum 1-hour for NO_2 concentrations (µg/m^3)

Receptor	Impact Opening Year 2021					Impact Design Year 2036				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	15.6	15.7	0.05	Imperceptible	Negligible Increase	15.8	15.8	0.05	Imperceptible	Negligible Increase
2	15.7	15.7	0.04	Imperceptible	Negligible Increase	15.8	15.8	0.04	Imperceptible	Negligible Increase
3	16.1	16.1	0.04	Imperceptible	Negligible Increase	16.3	16.3	0.04	Imperceptible	Negligible Increase

Table 10.9 - Annual Mean PM_{10} Concentrations (µg/m^3)

Receptor	Opening Year 2021		Design Year 2036	
	DN	DS	DN	DS
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0

Table 10.10 - Number of days with PM_{10} concentration > 50 µg/m^3

Receptor	Impact Opening Year 2021					Impact Design Year 2036				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	10.9	11.0	0.03	Imperceptible	Negligible Increase	11.0	11.1	0.03	Imperceptible	Negligible Increase
2	11.0	11.0	0.03	Imperceptible	Negligible Increase	11.0	11.1	0.03	Imperceptible	Negligible Increase
3	11.3	11.3	0.03	Imperceptible	Negligible Increase	11.4	11.4	0.03	Imperceptible	Negligible Increase

Table 10.11 - $PM_{2.5}$ Annual Mean $PM_{2.5}$ Concentrations (µg/m^3)

Receptor	Impact Opening Year 2021					Impact Design Year 2036				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	2.74	2.76	0.015	Imperceptible	Negligible Increase	2.78	2.79	0.015	Imperceptible	Negligible Increase
2	2.72	2.73	0.012	Imperceptible	Negligible Increase	2.75	2.76	0.012	Imperceptible	Negligible Increase
3	2.83	2.85	0.013	Imperceptible	Negligible Increase	2.88	2.90	0.013	Imperceptible	Negligible Increase

Table 10.12 - Maximum 8-hour CO Concentrations (mg/m^3)

Receptor	Impact Opening Year 2021					Impact Design Year 2036				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	1.06	1.06	0.004	Imperceptible	Negligible Increase	1.06	1.07	0.004	Imperceptible	Negligible Increase
2	1.05	1.05	0.003	Imperceptible	Negligible Increase	1.06	1.06	0.003	Imperceptible	Negligible Increase
3	1.07	1.08	0.003	Imperceptible	Negligible Increase	1.08	1.09	0.003	Imperceptible	Negligible Increase

Table 10.13 - Annual Mean Benzene Concentrations (µg/m^3)

Year	Scenario	VOC (kg/annum)	NO_X (kg/annum)	CO_2 (tonnes/annum)
2021	Do Nothing	476.8	1672.3	851.6
	Do Something	490.7	1717.9	876.1
2036	Do Nothing	548.5	1896.7	983.0
	Do Something	562.4	1941.7	1007.6
Increment in 2021		13.9 kg	45.5 kg	24.5 Tonnes
Increment in 2036		13.9 kg	45 kg	24.6 Tonnes
Emission Ceiling (kilo Tonnes) 2020		**56.8**	**66.2**	**37,943**
Emission Ceiling (kilo Tonnes) 2030		**51.5**	**40.2**	**37,943**
Impact in 2021 (%)		0.00002 %	0.0001 %	0.0001 %
Impact in 2036 (%)		0.00003 %	0.0001 %	0.0001 %

Table 10.14 - Regional Air Quality & Climate Assessment

10.11 Monitoring

Construction Phase

Monitoring of construction dust deposition at nearby sensitive receptors during the construction phase of the proposed development is recommended to ensure the mitigation measures are providing adequate dust minimisation. This can be carried out using the Bergerhoff method in accordance with the requirements of the German Standard VDI 2119. The Bergerhoff Gauge consists of a collecting vessel and a stand with a protecting gauge. The collecting vessel is secured to the stand with the opening of the collecting vessel located approximately 2m above ground level. The applicable limit value is the TA Luft limit value of 350 mg/(m^2*day) for a monitoring period of between 28 - 32 days.

Operational Phase

There is no monitoring recommended for the operational phase of the development as impacts to air quality and climate are predicted to be imperceptible.

10.12 Reinstatement

Not applicable to air quality and climate.

10.13 Interactions

The most significant interaction with respect to air quality and climate is with respect to traffic and transportation. Traffic data for the local road links affected by the proposed development and nearby developments for the opening and design years was provided for both the Do Nothing and Do Something Scenarios. This information has been used as an input for the air quality and climate assessment of the operational phase of the proposed development. The results of this assessment predict that the impacts to air quality and climate from a change in traffic flows as a result of the proposed development will be long-term and imperceptible.

Interactions between air quality and human beings can also be considered significant. An adverse impact to air quality during either the construction or operational phases has the potential to cause health impacts and dust nuisance issues. The dust mitigation measures that will be put in place on-site during construction will ensure that the impact of the development complies with all ambient air quality legislative limits and therefore the predicted impact is short-term and imperceptible with respect to air impacts on human health during the construction phase.

In relation to interactions between air quality and human health during the operational phase, the results of the quantitative assessment conducted to assess the air quality and climate impacts from changes in traffic flows during the operational phase of the assessment demonstrate that the impacts will be long-term and imperceptible. Results show that concentrations of ambient air pollutants with the proposed development in place will be compliant with all ambient air quality limit values which are based on the protection of human health.

10.14 Difficulties Encountered

There were no difficulties encountered while carrying out this assessment.

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Appendix 10.1 - Transport Infrastructure Ireland Significance Criteria for Air Quality

Magnitude of Change	Annual Mean NO_2 / PM_{10}	No. days with PM_{10} concentration > 50 μg/m^3	Annual Mean $PM_{2.5}$
Large	Increase / decrease ≥4 μg/m^3	Increase / decrease >4 days	Increase / decrease ≥2.5 μg/m^3
Medium	Increase / decrease 2 - <4 μg/m^3	Increase / decrease 3 or 4 days	Increase / decrease 1.25 - <2.5 μg/m^3
Small	Increase / decrease 0.4 - <2 μg/m^3	Increase / decrease 1 or 2 days	Increase / decrease 0.25 - <1.25 μg/m^3
Imperceptible	Increase / decrease <0.4 μg/m^3	Increase / decrease <1 day	Increase / decrease <0.25 μg/m^3

Table A11.1 - Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations

Absolute Concentration in Relation to Objective/Limit Value	Change in Concentration Note 1		
	Small	**Medium**	**Large**
Increase with Scheme			
Above Objective/Limit Value With Scheme (≥40 μg/m^3 of NO_2 or PM_{10}) (≥25 μg/m^3 of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value With Scheme (36 - <40 μg/m3 of NO_2 or PM_{10}) (22.5 - <25 μg/m^3 of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value With Scheme (30 - <36 μg/m3 of NO_2 or PM_{10}) (18.75 - <22.5 μg/m^3 of $PM_{2.5}$)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value With Scheme (<30 μg/m^3 of NO_2 or PM_{10}) (<18.75 μg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight Adverse
Decrease with Scheme			
Above Objective/Limit Value With Scheme (≥40 μg/m^3 of NO_2 or PM_{10}) (≥25 μg/m3 of $PM_{2.5}$)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value With Scheme (36 - <40 μg/m^3 of NO_2 or PM_{10}) (22.5 - <25 μg/m^3 of $PM_{2.5}$)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value With Scheme (30 - <36 μg/m^3 of NO_2 or PM_{10}) (18.75 - <22.5 μg/m^3 of $PM_{2.5}$)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value With Scheme (<30 μg/m^3 of NO_2 or PM_{10}) (<18.75 μg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight Beneficial

Table A11.2 - Air Quality Impact Significance Criteria For Annual Mean NO_2 and PM_{10} and $PM_{2.5}$ Concentrations at a Receptor

Note 1 *Well Below Standard = <75% of limit value.*

Absolute Concentration in Relation to Objective / Limit Value	**Change in Concentration** Note 1		
	Small	**Medium**	**Large**
Increase with Scheme			
Above Objective/Limit Value With Scheme (≥35 days)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value With Scheme (32 - <35 days)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value With Scheme (26 - <32 days)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value With Scheme (<26 days)	Negligible	Negligible	Slight Adverse
Decrease with Scheme			
Above Objective/Limit Value With Scheme (≥35 days)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value With Scheme (32 - <35 days)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value With Scheme (26 - <32 days)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value With Scheme (<26 days)	Negligible	Negligible	Slight Beneficial

Table A11.3 - Air Quality Impact Significance Criteria For Changes to Number of Days with PM_{10} Concentration Greater than 50 μg/m^3 at a Receptor

Note 1 Where the Impact Magnitude is Imperceptible, then the Impact Description is Negligible

Appendix 10.2 - Ambient Air Quality Standards

National standards for ambient air pollutants in Ireland have generally ensued from Council Directives enacted in the EU (& previously the EC & EEC). The initial interest in ambient air pollution legislation in the EU dates from the early 1980s and was in response to the most serious pollutant problems at that time which was the issue of acid rain. As a result of this sulphur dioxide, and later nitrogen dioxide, were both the focus of EU legislation. Linked to the acid rain problem was urban smog associated with fuel burning for space heating purposes. Also apparent at this time were the problems caused by leaded petrol and EU legislation was introduced to deal with this problem in the early 1980s.

In recent years the EU has focused on defining a basis strategy across the EU in relation to ambient air quality. In 1996, a Framework Directive, Council Directive 96/62/EC, on ambient air quality assessment and management was enacted. The aims of the Directive are fourfold. Firstly, the Directive's aim is to establish objectives for ambient air quality designed to avoid harmful effects to health. Secondly, the Directive aims to assess ambient air quality on the basis of common methods and criteria throughout the EU. Additionally, it is aimed to make information on air quality available to the public via alert thresholds and fourthly, it aims to maintain air quality where it is good and improve it in other cases.

As part of these measures to improve air quality, the European Commission has adopted proposals for daughter legislation under Directive 96/62/EC. The first of these directives to be enacted, Council Directive 1999/30/EC, has been passed into Irish Law as S.I. No 271 of 2002 (Air Quality Standards Regulations 2002), and has set limit values which came into operation on 17th June 2002. The Air Quality Standards Regulations 2002 detail margins of tolerance, which are trigger levels for certain types of action in the period leading to the attainment date. The margin of tolerance varies from 60% for lead, to 30% for 24-hour limit value for PM_{10}, 40% for the hourly and annual limit value for NO_2 and 26% for hourly SO_2 limit values. The margin of tolerance commenced from June 2002, and started to reduce from 1 January 2003 and every 12 months thereafter by equal annual percentages to reach 0% by the attainment date. A second daughter directive, EU Council Directive 2000/69/EC, has published limit values for both carbon monoxide and benzene in ambient air. This has also been passed into Irish Law under the Air Quality Standards Regulations 2002.

The most recent EU Council Directive on ambient air quality was published on the 11/06/08 which has been transposed into Irish Law as S.I. 180 of 2011. Council Directive 2008/50/EC combines the previous Air Quality Framework Directive and its subsequent daughter directives. Provisions were also made for the inclusion of new ambient limit values relating to $PM_{2.5}$. The margins of tolerance specific to each pollutant were also slightly adjusted from previous directives. In regards to existing ambient air quality standards, it is not proposed to modify the standards but to strengthen existing provisions to ensure that non-compliances are removed. In addition, new ambient standards for $PM_{2.5}$ are included in Directive 2008/50/EC. The approach for $PM_{2.5}$ was to establish a target value of 25 µg/m^3, as an annual average (to be attained everywhere by 2010) and a limit value of 25 µg/m^3, as an annual average (to be attained everywhere by 2015), coupled with a target to reduce human exposure generally to $PM_{2.5}$ between 2010 and 2020. This exposure reduction target will range from 0% (for $PM_{2.5}$ concentrations of less than 8.5 µg/m^3 to 20% of the average exposure indicator (AEI) for concentrations of between 18 - 22 µg/m^3). Where the AEI is currently greater than 22 µg/m^3 all appropriate measures should be employed to reduce this level to 18 µg/m^3 by 2020. The AEI is based on measurements taken in urban background locations averaged over a three year period from 2008 - 2010 and again from 2018-2020. Additionally, an exposure concentration obligation of 20 µg/m^3 was set to be complied with by 2015 again based on the AEI.

Although the EU Air Quality Limit Values are the basis of legislation, other thresholds outlined by the EU Directives are used which are triggers for particular actions. The Alert Threshold is defined in Council Directive 96/62/EC as "a level beyond which there is a risk to human health from brief exposure and at which immediate steps shall be taken as laid down in Directive 96/62/EC". These steps include undertaking to ensure that the necessary steps are taken to inform the public (e.g. by means of radio, television and the press).

The Margin of Tolerance is defined in Council Directive 96/62/EC as a concentration which is higher than the limit value when legislation comes into force. It decreases to meet the limit value by the attainment date. The Upper Assessment Threshold is defined in Council Directive 96/62/EC as a concentration above which high quality measurement is mandatory. Data from measurement may be supplemented by information from other sources, including air quality modelling.

An annual average limit for both NO_X (NO and NO_2) is applicable for the protection of vegetation in highly rural areas away from major sources of NO_X such as large conurbations, factories and high road vehicle activity such as a dual carriageway or motorway. Annex VI of EU Directive 1999/30/EC identifies that monitoring to demonstrate compliance with the NO_X limit for the protection of vegetation should be carried out distances greater than:

- 5 km from the nearest motorway or dual carriageway
- 5 km from the nearest major industrial installation
- 20 km from a major urban conurbation

As a guideline, a monitoring station should be indicative of approximately 1000 km^2 of surrounding area.

Under the terms of EU Framework Directive on Ambient Air Quality (96/62/EC), geographical areas within member states have been classified in terms of zones. The zones have been defined in order to meet the criteria for air quality monitoring, assessment and management as described in the Framework Directive and Daughter Directives. Zone A is defined as Dublin and its environs, Zone B is defined as Cork City, Zone C is defined as 23 urban areas with a population greater than 15,000 and Zone D is defined as the remainder of the country. The Zones were defined based on among other things, population and existing ambient air quality.

EU Council Directive 96/62/EC on ambient air quality and assessment has been adopted into Irish Legislation (S.I. No. 33 of 1999). The act has designated the Environmental Protection Agency (EPA) as the competent authority responsible for the implementation of the Directive and for assessing ambient air quality in the State. Other commonly referenced ambient air quality standards include the World Health Organisation. The WHO guidelines differ from air quality standards in that they are primarily set to protect public health from the effects of air pollution. Air quality standards, however, are air quality guidelines recommended by governments, for which additional factors, such as socio-economic factors, may be considered.

Air Dispersion Modelling

The inputs to the DMRB model consist of information on road layouts, receptor locations, annual average daily traffic movements, annual average traffic speeds and background concentrations (UK DEFRA 2016). Using this input data the model predicts ambient ground level concentrations at the worst-case sensitive receptor using generic meteorological data.

The DMRB has recently undergone an extensive validation exercise (UK DEFRA 2018) as part of the UK's Review and Assessment Process to designate areas as Air Quality Management Areas (AQMAs). The validation exercise was carried out at 12 monitoring sites within the UK DEFRAs national air quality monitoring network. The validation exercise was carried out for NO_X, NO_2 and PM_{10}, and included urban background and kerbside/roadside locations, "open" and "confined" settings and a variety of geographical locations (UK DEFRA 2018).

In relation to NO_2, the model generally over-predicts concentrations, with a greater degree of over-prediction at "open" site locations. The performance of the model with respect to NO_2 mirrors that of NO_X showing that the over-prediction is due to NO_X calculations rather than the NO_X:NO_2 conversion. Within most urban situations, the model overestimates annual mean NO_2 concentrations by between 0 to 40% at confined locations and by 20 to 60% at open locations. The performance is considered comparable with that of sophisticated dispersion models when applied to situations where specific local validation corrections have not been carried out.

The model also tends to over-predict PM_{10}. Within most urban situations, the model will over-estimate annual mean PM_{10} concentrations by between 20 to 40%. The performance is comparable to more sophisticated models, which, if not validated locally, can be expected to predict concentrations within the range of $\pm$50%.

Thus, the validation exercise has confirmed that the model is a useful screening tool for the Second Stage Review and Assessment, for which a conservative approach is applicable (UK DEFRA 2018).

Appendix 10.3 - Dust Minimisation Plan

The objective of dust control at the site is to ensure that no significant nuisance occurs at nearby sensitive receptors. In order to develop a workable and transparent dust control strategy, the following management plan has been formulated by drawing on best practice guidance from Ireland, the UK (IAQM 2014, BRE 2003, Scottish Office 1996 and UK ODPM 2002). and the USA (USEPA 1997).

Site Management

The aim is to ensure good site management by avoiding dust becoming airborne at source. This will be done through good design and effective control strategies.

At the construction planning stage, the siting of activities and storage piles will take note of the location of sensitive receptors and prevailing wind directions in order to minimise the potential for significant dust nuisance (see Figure 10.2 for the windrose for Dublin Airport). As the prevailing wind is predominantly westerly to south-westerly, locating construction compounds and storage piles downwind of sensitive receptors will minimise the potential for dust nuisance to occur at sensitive receptors.

Good site management will include the ability to respond to adverse weather conditions by either restricting operations on-site or quickly implementing effective control measures before the potential for nuisance occurs. When rainfall is greater than 0.2mm/day, dust generation is generally suppressed (BRE 2003, UK ODPM 2002). The potential for significant dust generation is also reliant on threshold wind speeds of greater than 10 m/s (19.4 knots) (at 7m above ground) to release loose material from storage piles and other exposed materials (USEPA 1986). Particular care should be taken during periods of high winds (gales) as these are periods where the potential for significant dust emissions are highest. The prevailing meteorological conditions in the vicinity of the site are favourable in general for the suppression of dust for a significant period of the year. Nevertheless, there will be infrequent periods were care will be needed to ensure that dust nuisance does not occur. The following measures shall be taken in order to avoid dust nuisance occurring under unfavourable meteorological conditions:

- The Principal Contractor or equivalent must monitor the contractors' performance to ensure that the proposed mitigation measures are implemented and that dust impacts and nuisance are minimised;
- During working hours, dust control methods will be monitored as appropriate, depending on the prevailing meteorological conditions;
- The name and contact details of a person to contact regarding air quality and dust issues shall be displayed on the site boundary, this notice board should also include head/regional office contact details;
- It is recommended that community engagement be undertaken before works commence on site explaining the nature and duration of the works to local residents and businesses;
- A complaints register will be kept on site detailing all telephone calls and letters of complaint received in connection with dust nuisance or air quality concerns, together with details of any remedial actions carried out;
- It is the responsibility of the contractor at all times to demonstrate full compliance with the dust control conditions herein;
- At all times, the procedures put in place will be strictly monitored and assessed.
- The dust minimisation measures shall be reviewed at regular intervals during the works to ensure the effectiveness of the procedures in place and to maintain the goal of minimisation of dust through the use of best practice and procedures. In the event of dust nuisance occurring outside the site boundary, site activities will be reviewed and satisfactory procedures implemented to rectify the problem. Specific dust control measures to be employed are described below.

Site Roads / Haulage Routes

Movement of construction trucks along site roads (particularly unpaved roads) can be a significant source of fugitive dust if control measures are not in place. The most effective means of suppressing dust emissions from unpaved roads is to apply speed restrictions. Studies show that these measures can have a control efficiency ranging from 25 to 80%(UK ODPM 2002).

- A speed restriction of 20 km/hr will be applied as an effective control measure for dust for on-site vehicles using unpaved site roads;
- Access gates to the site shall be located at least 10m from sensitive receptors where possible;
- Bowsers or suitable watering equipment will be available during periods of dry weather throughout the construction period. Research has found that watering can reduce dust emissions by 50% (USEPA, 1997). Watering shall be conducted during sustained dry periods to ensure that unpaved areas are kept moist. The required application frequency will vary according to soil type, weather conditions and vehicular use;
- Any hard surface roads will be swept to remove mud and aggregate materials from their surface while any unsurfaced roads shall be restricted to essential site traffic only.

Land Clearing / Earth Moving

Land clearing / earth-moving works during periods of high winds and dry weather conditions can be a significant source of dust.

- During dry and windy periods, and when there is a likelihood of dust nuisance, watering shall be conducted to ensure moisture content of materials being moved is high enough to increase the stability of the soil and thus suppress dust;
- During periods of very high winds (gales), activities likely to generate significant dust emissions should be postponed until the gale has subsided.

Storage Piles

The location and moisture content of storage piles are important factors which determine their potential for dust emissions.

- Overburden material will be protected from exposure to wind by storing the material in sheltered regions of the site. Where possible storage piles should be located downwind of sensitive receptors;
- Regular watering will take place to ensure the moisture content is high enough to increase the stability of the soil and thus suppress dust. The regular watering of stockpiles has been found to have an 80% control efficiency (UK ODPM 2002);
- Where feasible, hoarding will be erected around site boundaries to reduce visual impact. This will also have an added benefit of preventing larger particles from impacting on nearby sensitive receptors.

Site Traffic on Public Roads

Spillage and blow-off of debris, aggregates and fine material onto public roads should be reduced to a minimum by employing the following measures:

- Vehicles delivering or collecting material with potential for dust emissions shall be enclosed or covered with tarpaulin at all times to restrict the escape of dust;
- At the main site traffic exits, a wheel wash facility shall be installed if feasible. All trucks leaving the site must pass through the wheel wash. In addition, public roads outside the site

shall be regularly inspected for cleanliness, as a minimum on a daily basis, and cleaned as necessary.

Summary of Dust Mitigation Measures

The pro-active control of fugitive dust will ensure that the prevention of significant emissions, rather than an inefficient attempt to control them once they have been released, will contribute towards the satisfactory performance of the contractor. The key features with respect to control of dust will be:

- The specification of a site policy on dust and the identification of the site management responsibilities for dust issues;
- The development of a documented system for managing site practices with regard to dust control;
- The development of a means by which the performance of the dust minimisation plan can be regularly monitored and assessed; and
- The specification of effective measures to deal with any complaints received.