10.0 AIR QUALITY AND CLIMATE

10.1 INTRODUCTION

Planning permission is sought for a residential development at the former Magee Barracks in Kildare Town, Co. Kildare. AWN Consulting Limited has been commissioned to conduct an assessment of the likely air quality and climate impacts associated with the proposed development.

This chapter was prepared by Dr. Avril Challoner, a Senior Consultant in the Air Quality section of AWN Consulting. Dr. Challoner holds a BEng (Hons) in Environmental Engineering from the National University of Ireland Galway, a HDip in Statistics from Trinity College Dublin and has completed a PhD in Environmental Engineering (Air Quality) in Trinity College Dublin. She is a Chartered Scientist (CSci), Member of the Institute of Air Quality Management and specialises in the fields of air quality, EIA and air dispersion modelling.

10.2 STUDY METHODOLOGY

This section outlines the methodology to be used to assess the air quality and climate impacts of the proposed development.

10.2.1 Background Information

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 SO_2, NO_2, PM_{10}, $PM_{2.5}$, benzene and CO (see Table 10.1). Council Directive 2008/50/EC combines the previous Air Quality Framework Directive (96/62/EC) and its subsequent daughter directives (including 1999/30/EC and 2000/69/EC).

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 regard 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)[1] 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[2] apply the Bergerhoff limit of 350 mg/(m^2*day) to the site boundary of quarries. This limit value can also be implemented with regard to 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[3,4]. 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[5]. 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 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 established at COP21 in Paris in 2015 and is an important milestone in terms of international climate change agreements. The Paris Agreement, agreed by over 200 nations, 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, on the 23rd/24th of October 2014, agreed the “2030 Climate and Energy Policy Framework”[6]. 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 objective of the Protocol is to control and reduce emissions of Sulphur Dioxide (SO_2), Nitrogen Oxides (NO_X), Volatile Organic Compounds (VOCs) and Ammonia (NH_3). 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 $PM_{2.5}$. In relation to Ireland, 2020 emission targets are 25 kt for SO_2 (65% on 2005 levels), 65 kt for NO_X (49% reduction on 2005 levels), 43 kt for VOCs (25% reduction on 2005 levels), 108 kt for NH_3 (1% reduction on 2005 levels) and 10 kt for $PM_{2.5}$ (18% reduction on 2005 levels).

European Commission Directive 2001/81/EC, the National Emissions Ceiling Directive (NECD), prescribes the same emission limits. Road traffic emissions of Nitrogen Oxides (NO_X) and Volatile Organic Compounds (VOCs) are important, accounting for 37% and 38% respectively of total emissions of these pollutants in Ireland in 2001(7,8). A National Programme for the progressive reduction of emissions of these four transboundary pollutants has been in place since April 2005(9). Data available from the EU in 2010 indicated that Ireland complied with the emissions ceilings for SO_2, VOCs and NH_3 but failed to comply with the ceiling for NO_X(9). 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, 2020-29 emission targets are for SO_2 (65% below 2005 levels), for NO_X (49% reduction), for VOCs (25% reduction), for NH_3 (1% reduction) and for $PM_{2.5}$ (18% reduction). In relation to 2030, Ireland's emission targets are for SO_2 (85% below 2005 levels), for NO_X (69% reduction), for VOCs (32% reduction), for NH_3 (5% reduction) and for $PM_{2.5}$ (41% reduction).

Table 10.1 Air Quality Standards Regulations (based on EU Council Directive 2008/50/EC

Pollutant	Regulation	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 NO_2
		Annual limit for protection of human health	40 μg/m^3 NO_2
		Critical limit 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 PM_{10}
		Annual limit for protection of human health	40 μg/m^3 PM_{10}
$PM_{2.5}$	2008/50/EC	Annual limit for protection of human health	25 μg/m^3 $PM_{2.5}$
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)
Dust Deposition	German TA-Luft	Annual average guideline for protection of nuisance and human health	350 mg/(m^2*day)

10.2.2 Local Air Quality Assessment

The air quality assessment was carried out following procedures described in the publications by the EPA[10,11] and using the methodology outlined in the policy and technical guidance notes, LAQM.PG(16) and LAQM.TG(16), issued by UK Department for Environment, Food and Rural Affairs[12-16]. The assessment of air quality was carried out using a phased approach as recommended by the UK Department for Environment, Food and Rural Affairs[15]. 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.

An examination of recent EPA and Local Authority data in Ireland[17,18], indicated that SO_2 and smoke and CO are unlikely to be exceeded at locations such as the site and environs of the proposed development, and thus these pollutants do not require detailed monitoring or assessment to be carried out. However, the analysis did indicate potential problems in regards to nitrogen dioxide (NO_2) and PM_{10} at busy junctions in urban centres[17,18]. Benzene, although previously reported at quite high levels in urban centres[17,18], has recently been measured at several city centre locations to be well below the EU limit value[17,18]. 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[17,18]. In view of this, the pollutants reviewed in this assessment are NO_2, PM_{10}, $PM_{2.5,}$ benzene and CO, with particular focus on NO_2 and PM_{10}.

Key pollutant concentrations were predicted for nearby sensitive receptors for the following five scenarios:

- The Existing Scenario (2019), for model verification;
- Opening Year Do-Nothing Scenario, which assumes the retention of present site usage with no development in place (2022);
- Opening Year Do-Something Scenario, which assumes the proposed development in place (2022);
- Design Year Do-Nothing Scenario, which assumes the retention of present site usage with no development in place (2037); and
- Design Year Do-Something Scenario, which assumes the proposed development in place (2037).

The assessment methodology involved air dispersion modelling using the UK Design Manual for Roads and Bridges Screening Model[15] (Version 1.03c, July 2007), the NO_x to NO_2 Conversion Spreadsheet[19] (Version 6.1) and following guidance issued by Transport Infrastructure Ireland[20], the UK Highways Agency[15], UK Department for Environment, Food and Rural Affairs[12] and the EPA[17,18].

Transport Infrastructure Ireland guidance 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 Design Manual for Roads and Bridges guidance[15], on which Transport Infrastructure Ireland 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;
- HGVs 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 were calculated at sensitive receptors which have the potential to be affected by the proposed development. For road links which were deemed to be affected by the proposed development and within 200 m of the chosen sensitive receptors inputs to the air dispersion model consisted of road layouts, receptor locations, annual average daily traffic movements (AADT), percentage heavy goods vehicles, annual average traffic speeds and background concentrations. The UK Design Manual for Roads and Bridges 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 this input data the model predicted the road traffic contribution to ambient ground level concentrations at the worst-case sensitive receptors using generic meteorological data. The Design Manual for Roads and Bridges model uses conservative emission factors, the formulae for which are outlined in the Design Manual for Roads and Bridges Volume 11 Section 3 Part 1 – HA 207/07 Annexes B3 and B4. These worst-case road contributions were then added to the existing background concentrations to give the worst-case predicted ambient concentrations. The worst-case predicted ambient concentrations were then compared with the relevant ambient air quality standards to assess the compliance of the proposed scheme with these ambient air quality standards.

Transport Infrastructure Ireland *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes*[20] detail a methodology for determining air quality impact significance criteria for road schemes. The degree of impact is determined based on both the absolute and relative impact of the Proposed Scheme. Transport Infrastructure Ireland significance criteria have been adopted for the proposed development and are detailed in Table 10.2 to Table 10.4. 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.

Table 10.2 Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations

Magnitude of Change	Annual Mean NO_2 / PM_{10}	No. days with PM_{10} concentration > 50 µg/m³	Annual Mean $PM_{2.5}$
Large	Increase / decrease ≥4 µg/m³	Increase / decrease >4 days	Increase / decrease ≥2.5 µg/m³
Medium	Increase / decrease 2 - <4 µg/m³	Increase / decrease 3 or 4 days	Increase / decrease 1.25 - <2.5 µg/m³
Small	Increase / decrease 0.4 - <2 µg/m³	Increase / decrease 1 or 2 days	Increase / decrease 0.25 - <1.25 µg/m³
Imperceptible	Increase / decrease <0.4 µg/m³	Increase / decrease <1 day	Increase / decrease <0.25 µg/m³

Source: Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes – Transport Infrastructure Ireland (2011)

Table 10.3 Air Quality Impact Significance Criteria For Annual Mean NO_2 and PM_{10} and $PM_{2.5}$ Concentrations at a Receptor

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/m^3 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/m^3 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/m^3 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

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

Source: Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes – Transport Infrastructure Ireland (2011)

Table 10.4 Air Quality Impact Significance Criteria for Changes to Number of Days with PM_{10} Concentration Greater than 50 µg/m^3 at a Receptor

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

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

Source: Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes – Transport Infrastructure Ireland (2011)

10.2.3 Dust

The greatest potential impact on air quality during the construction phase is from construction dust emissions, PM_{10}/$PM_{2.5}$ emissions and the potential for nuisance dust.

Dust is characterised as encompassing particulate matter with a particle size of between 1 and 75 microns (1- 75 µm), therefore includes both PM_{10} and $PM_{2.5}$. Deposition typically occurs in close proximity to each site and potential impacts generally occur within 500 metres of the dust generating activity as dust particles fall out of suspension in the air. Sensitivity to dust depends on the duration of the dust deposition, the dust generating activity, and the nature of the deposit. Therefore, a higher tolerance of dust deposition is likely to be shown if only short periods of dust deposition are expected and the dust generating activity is either expected to stop or move on.

An appraisal has been carried out to assess the risk to sensitive receptors of dust soiling and health impacts due to the construction phase in accordance to the Institute of Air Quality Management's publication *Guidance on the Assessment of Dust from Demolition and Construction* (2014)[21]. As shown in Table 10.5 below the risk from dust soiling at the nearest sensitive receptor (a high sensitivity residential environment, distance <20 m) is considered high under the IAQM guidance. There are between 10 and 100 high sensitivity receptors (i.e. residential dwellings) which are less than 20 metres from the site boundary. As result, the sensitivity of the area to dust soiling effects on people and property is high according to IAQM guidance without adequate mitigation.

Table 10.5 Sensitivity of the Area to Dust Soiling Effects on People and Property

Receptor Sensitivity	Number Of Receptors	Distance from source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	**High**	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

In addition, the IAQM guidelines also outline the criteria for assessing the impact of PM_{10} emissions from construction activities based on the current annual mean PM_{10} concentration, receptor sensitivity and the number of receptors affected. The current PM_{10} concentration in Zone C locations as reported in Section 10.3.3 of the EIS below is approximately 20 µg/m^3. As shown in Table 10.6 below the worst-case sensitivity of the area to human health impacts from PM_{10} (high sensitivity, distance <20 m and with receptor numbers 10-100) is considered low under this guidance without adequate mitigation.

Table 10.6 Sensitivity of the Area to Human Health Impacts

Receptor Sensitivity	Annual Mean PM_{10} Concentration	Number of Receptors	Distance from source (m)			
			<20	<50	<100	<200
High	< 24 µg/m^3	>100	Medium	Low	Low	Low
		10-100	**Low**	Low	Low	Low
		1-10	Low	Low	Low	Low
Medium	< 24 µg/m^3	>10	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
Low	< 24 µg/m^3	>1	Low	Low	Low	Low

Dust deposition impacts on ecology can occur due to chemical or physical effects. This includes reduction in photosynthesis due to smothering from dust on the plants and chemical changes such as acidity to soils. Often impacts will be reversible once the works are completed, and dust deposition cease. There are no designated areas within a range that have the potential to be impacted due to construction dust; therefore no ecology assessment is required.

In order to determine the level of dust mitigation required during the proposed demolition and construction phases, the potential dust emission magnitude for each dust generating activity needs to be taken into account, along with the already established sensitivity of the area. These major dust generating activities are divided into four types to reflect their different potential impacts. These are:

- Demolition;
- Earthworks;
- Construction; and
- Trackout.

10.2.4 Regional Air Quality 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[20]and the methodology provided in Annex 2 in the UK Design Manual for Roads and Bridges[15]. The assessment focused on determining the resulting change in emissions of volatile organic compounds (VOCs), nitrogen oxides (NO_x) and carbon dioxide (CO_2). The Annex provides a method for the prediction of the regional impact of emissions of these pollutants from road schemes. The inputs to the air dispersion model consist of information on road link lengths, AADT movements and annual average traffic speeds.

10.2.5 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 HGV's 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"*[20]. Transport Infrastructure Ireland guidelines recommend the use of the UK Department for Environment, Food and Rural Affairs NO_x to NO_2 calculator [19] which was originally published in 2009 and is currently on version 6.1. 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 Transport Infrastructure Ireland guidance recommends the use of Craigavon as the choice for local authority when using the calculator. The choice of *Armagh, Banbridge and 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.

10.2.6 Ecological Sites

For routes which pass within 2 km of a designated area of conservation (either Irish or European designation) Transport Infrastructure Ireland requires consultation with an Ecologist [20]. However, in practice the potential for impact to an ecological site is highest within 200 m of the Proposed Development and when significant changes in AADT (>5%) occur.

Transport Infrastructure Ireland's *Guidelines for Assessment of Ecological Impacts of National Road Schemes*[22] and Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities[23]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 should 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 sites within the vicinity of the proposed development; therefore no further assessment is needed.

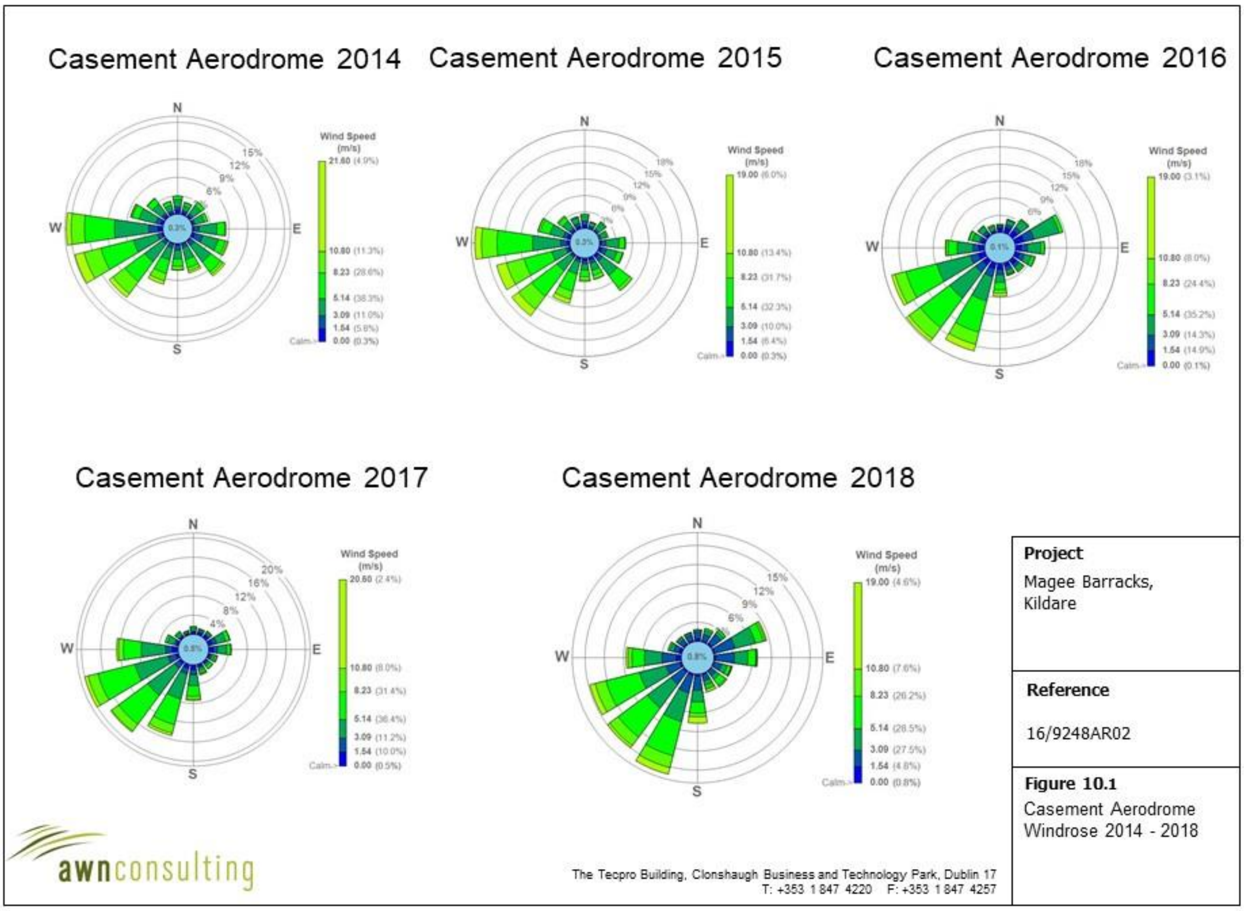
10.3 THE EXISTING RECEIVING ENVIRONMENT (BASELINE SITUATION)

10.3.1 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)[24]. 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 nearest representative weather station collating detailed weather records is Casement Aerodrome, which is located approximately 32 km north-east of the site. Casement Aerodrome met data has been examined to identify the prevailing wind direction and average wind speeds over a five-year period (see Figure 10.1). For data collated during five representative years (2014 - 2018), the predominant wind direction is south-westerly to westerly, with generally moderate wind speeds averaging 5.5 m/s.

Fig. 10.1: Casement Aerodrome windrose 2014 - 2018



10.3.2 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(15). 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 2011 the UK Department for Environment, Food and Rural Affairs published research(25) on the long term trends in NO_2 and NO_x for roadside monitoring sites in the UK. This study found a marked 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 study is that there now exists a gap between projected NO_2 concentrations which UK Department for Environment, Food and Rural Affairs previously published and monitored concentrations. The impact of this 'gap' is that the Design Manual for Roads and Bridges screening model can under-predict NO_2 concentrations predicted for future years. Subsequently, the UK Highways Agency published an Interim advice note (IAN 170/12)(26)in order to correct the Design Manual for Roads and Bridges results for future years.

10.3.3 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 the "*Air Quality In Ireland 2017*"(18). 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 (18).

In terms of air monitoring and assessment, the Magee Barracks site is within the Zone C which represents 23 towns with a population of greater than 15,000(18). The long-term 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(17,18) at suburban locations in Kilkenny and Portlaoise show that current levels of NO_2 are below both the annual and 1-hour limit values (see Table 10.7), with average levels ranging from 5 - 11 µg/m^3 in 2017. Based on these results, a conservative estimate of the background NO_2 concentration in the region of the proposed residential development at Magee Barracks in 2017 is 11 µg/m^3.

Table 10.7 Trends In Zone C Air Quality – Nitrogen Dioxide (NO_2)

Station	Averaging Period	Year					
		2012	2013	2014	2015	2016	2017
Kilkenny	Annual Mean NO_2 (µg/m^3)Note 1	4	4	5	5	7	5
	Max 1-hr NO_2 (µg/m^3)Note 2	62	90	57	70	43	40
Portlaoise	Annual Mean NO_2 (µg/m^3)	-	-	16	10	11	11
	Max 1-hr NO_2 (µg/m^3)	-	-	74	84	67	60

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 Galway and Ennis showed 2017 annual mean concentrations of 9.5 - 15.8 µg/m^3 (Table 10.8), with at most 12 exceedances (in Ennis) of the 24-hour limit value of 50 µg/m^3 (35 exceedances are permitted per year)(18). A conservative estimate of the background PM_{10} concentration in the region of the proposed residential development at Magee Barracks in 2017 is 16 µg/m^3.

Table 10.8 Trends In Trends In Zone C Air Quality – PM_{10}

Station	Averaging Period	Year				
		2013	2014	2015	2016	2017
Galway	Annual Mean PM_{10} ($\mu g/m^3$) Note 1	21	15	15	15	-
	24-hr Mean > 50 $\mu g/m^3$ Note 2 (days)	11	0	2	3	-
Ennis	Annual Mean PM_{10} ($\mu g/m^3$)	20	21	18	17	16
	24-hr Mean > 50 $\mu g/m^3$ (days)	8	8	10	12	9
Portlaoise	Annual Mean PM_{10} ($\mu g/m^3$)	-	-	-	-	9.5
	24-hr Mean > 50 $\mu g/m^3$ (days)	-	-	-	-	1

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

Note 2 24-hour limit value - 50 $\mu g/m^3$ as a 90.4th%ile, i.e. not to be exceeded >35 times per year (EU Council Directive 1999/30/EC & S.I. No. 180 of 2011).

Continuous $PM_{2.5}$ monitoring carried out at the Zone C locations of Ennis and Bray showed average levels of 5.2 – 10.6 $\mu g/m^3$ respectively in 2017. The annual average level measured in Ennis in 2017 was 10.6 $\mu g/m^3$, with an average $PM_{2.5}$ /PM_{10} ratio of 0.67. Based on this information, a ratio of 0.7 was used to generate a background $PM_{2.5}$ concentration in the region of the proposed residential development at Magee Barracks in 2017 of 11 $\mu g/m^3$.

In terms of benzene, the annual mean concentration in the Zone C monitoring location of Kilkenny for 2017 was 0.17 $\mu g/m^3$. This is well below the limit value of 5 $\mu g/m^3$.Between 2014 to 2017 annual mean concentrations at Zone C sites ranged from 0.09 – 0.2 $\mu g/m^3$. Based on this EPA data, a conservative estimate of the background benzene concentration at the proposed Magee Barracks residential development in 2017 is 0.2 $\mu g/m^3$.

With regard to CO, annual averages at the Zone C location of Portlaoise are low, peaking at 0.15 mg/m^3 of the limit value (10 mg/m^3)[17,18] in 2014 to 2017. Based on this EPA data, a conservative estimate of the background CO concentration in the region of the development in 2017 is 0.15 mg/m^3.

10.4 CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

The former Magee Barracks site is a brownfield site located to the east of Kildare Town Centre. The surrounding land use in the vicinity of the site is predominantly residential with a small number of commercial properties to the south of the site. All buildings currently on site are to be demolished. A detailed description of the proposed development is provided in Chapter 2 of this EIAR.

The development has an opening year of 2022. 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:

A. Construction Phase; and;
B. Operational Phase.

The primary sources of air and climatic emissions in the operational context are deemed long term and will involve the change in traffic flows or congestion in the local areas which are associated with the development.

During the operational phase of the development there will be different sources of potential air quality impacts. The following section describes the primary sources of potential air quality impacts which are deemed long-term and which have been assessed in detail as part of this EIAR.

10.5 POTENTIAL IMPACT OF THE PROPOSED DEVELOPMENT

10.5.1 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 Institute of Air Quality Management *Guidance on the Assessment of Dust from Demolition and Construction*(21) states that site traffic and plant is unlikely to make a significant impact on local air quality, dust being the exception to this.

Material handling activities, including excavation and backfill on site, may typically emit dust. The potential for dust to be emitted will depend on the type of activity being carried out in conjunction with environmental factors including levels of rainfall, wind speed and wind direction. Activities associated with this development such as excavation and backfill have potential to generate dust.

As indicated, dust generation rates depend on the site activity, particle size (in particular the silt content, defined as particles smaller than 75 microns in size), the moisture content of the material and weather conditions. Dust emissions are dramatically reduced where rainfall has occurred due to the cohesion created between dust particles and water and the removal of suspended dust from the air. It is typical to assume no dust is generated under “wet day” conditions where rainfall greater than 0.2 mm has fallen. Information collected from Casement Meteorological Station (1981-2010) identified that typically 183 days per annum are “wet”. Thus, almost 50% of the time no significant dust generation will be likely due to meteorological conditions.

Large particle sizes (greater than 75 microns) fall rapidly out of atmospheric suspension and are subsequently deposited in close proximity to the source. Particle sizes of less than 75 microns are of interest as they can remain airborne for greater distances and can give rise to the potential dust nuisance at the sensitive receptors. This size range would broadly be described as silt. Emission rates are normally predicted on a site-specific particle size distribution for each dust emission source. There are sensitive receptors in all directions surrounding the site, in particular the medical centre to the south and school to thenorth west. Many of these houses are set less than 20 m back from the road and from the site boundary, therefore mitigation measures will be required to ensure any potential impacts are minimised or removed.

Whilst construction activities are likely to produce some level of dust during earth moving and excavating phases of the project, these activities will mainly be confined to particles of dust greater than 10 microns. Particles of dust greater than 10 microns are considered a nuisance but do not have the potential to cause significant health impacts.

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. While construction dust tends to be deposited within 200m of a construction site, the majority of the deposition occurs within the first 50m. The following paragraphs use the appraisal method as discussed in Section 10.2.2 to assess the risk to sensitive receptors of dust soiling and health impacts due to the construction phase in accordance to the Institute of Air Quality Management's publication *Guidance on the Assessment of Dust from Demolition and Construction.*

Demolition

Demolition will primarily involve removal of an area of 16,320 m^2 of existing buildings in order to facilitate construction. Dust emission magnitude from demolition can be classified as small, medium or large and are described below.

- **Large:** Total building volume >50,000 m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20 m above ground level.
- **Medium:** Total building volume 20,000 m^3 – 50,000 m^3, potentially dusty construction material, demolition activities 10-20 m above ground level.
- **Small:** Total building volume 20,000 m^3, construction material with low potential for dust release, demolition activities <10 m above ground, demolition occurring during wetter months.

The dust emission magnitude for the proposed demolition activities can be classified as medium, due to the volume involved. This results in an overall <u>medium</u> risk of <u>temporary</u> dust soiling impacts (as it is high sensitivity area in terms of dust soiling) and an overall <u>low</u> risk of <u>temporary</u> human health impacts (as it is a low sensitivity area in terms of human health) as a result of the proposed demolition activities as outlined in Table 10.9. Overall, in order to ensure that no dust nuisance occurs during the demolition activities, a range of dust mitigation measures associated with a <u>medium</u> risk of dust impacts must be implemented. When the dust mitigation measures detailed Section 10.8.1 and in Appendix 10.2 of the EIS are implemented, fugitive emissions of dust from the site will be <u>insignificant</u> at nearby receptors.

Table 10.9 Risk of Dust Impacts – Demolition

Sensitivity of Area	Dust Emission Magnitude		
	Large	**Medium**	**Small**
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Earthworks

Earthworks will primarily involve excavating material, haulage, tipping and stockpiling. This may also involve levelling the site and landscaping. Dust emission magnitude from earthworks can be classified as small, medium or large and are described below.

- **Large:** Total site area > 10,000 m^2, potentially dusty soil type (e.g. clay which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds > 8m in height, total material moved >100,000 tonnes.
- **Medium:** Total site area 2,500 m^2 – 10,000 m^2, moderately dusty soil type (e.g. silt), 5 - 10 heavy earth moving vehicles active at any one time, formation of bunds 4 – 8 m in height, total material moved 20,000 – 100,000 tonnes.
- **Small:** Total site area < 2,500 m^2, soil type with large grain size (e.g. sand), < 5 heavy earth moving vehicles active at any one time, formation of bunds < 4 m in height, total material moved < 20,000 tonnes, earthworks during wetter months.

The dust emission magnitude for the proposed earthwork activities can be classified as large. This is due to the total site area being greater than 10,000 m^2. This results in an overall high risk of temporary dust soiling impacts and an overall low risk of temporary human health impacts as a result of the proposed earthworks activities as outlined in Table 10.10. Overall, in order to ensure that no dust nuisance occurs during the earthworks activities, a range of dust mitigation measures associated with a high risk of dust impacts must be implemented. When the robust dust mitigation measures detailed in the mitigation section of this chapter are implemented, fugitive emissions of dust from the site will be insignificant at nearby receptors.

Table 10.10 Risk of Dust Impacts – Earthworks

Sensitivity of Area	Dust Emission Magnitude		
	Large	**Medium**	**Small**
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Construction

Dust emission magnitudes from construction can be classified as small, medium or large and are described below.

- **Large:** Total building volume > 100,000 m^3, on-site concrete batching, sandblasting.
- **Medium:** Total building volume 25,000 m^3 – 100,000 m^3, potentially dusty construction material (e.g. concrete), on-site concrete batching.
- **Small:** Total building volume < 25,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber).

The dust emission magnitude for the proposed construction activities, can be classified as medium. The total building volume will be between 25,000 m^3 – 100,000m^3 if phase one and two are combined, however it is unlikely that any sandblasting will occur onsite due to the sensitive nature of the site. This results in an overall medium risk of temporary dust soiling impacts and an overall low risk of temporary human health impacts as a result of the proposed construction activities as outlined in Table 10.11. Overall, in order to ensure that no dust nuisance occurs during the construction activities, a range of dust mitigation measures associated with a medium risk of dust impacts must be implemented. When the dust mitigation measures detailed in the mitigation section of this chapter are implemented, fugitive emissions of dust from the site will be insignificant at nearby receptors.

Table 10.11 Risk of Dust Impacts – Construction

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Trackout

Factors which determine the dust emission magnitude are vehicle size, vehicle speed, vehicle numbers, geology and duration. Dust emission magnitude from trackout can be classified as small, medium or large and are described below.

- **Large:** > 50 HDV (> 3.5 t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length > 100 m
- **Medium:** 10 - 50 HDV (> 3.5 t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 - 100 m
- **Small:** < 10 HDV (> 3.5 t) outward movements in any one day, surface material with low potential for dust release, unpaved road length < 50 m.

This results in the dust emission magnitude from trackout activities being classified as medium. This results in an overall medium risk of temporary dust soiling impacts and an overall low risk of temporary human health impacts as a result of the proposed trackout activities as outlined in Table 10.12. Overall, in order to ensure that no dust nuisance occurs during the trackout activities, a range of dust mitigation measures associated with a medium risk of dust impacts must be implemented. When the dust mitigation measures detailed in the mitigation section of this chapter are implemented, fugitive emissions of dust from the site will be insignificant at nearby receptors.

Table 10.12 Risk of Dust Impacts – Trackout

Sensitivity of Area	Dust Emission Magnitude		
	Large	**Medium**	**Small**
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table 10.13 Summary of Dust Risk to Define Site-Specific Mitigation

Potential Impact	Dust Emission Magnitude			
	Demolition	**Earthworks**	**Construction**	**Trackout**
Dust Soiling	Medium Risk	High Risk	Medium Risk	Medium Risk
Human Health	Low Risk	Low Risk	Low Risk	Low Risk

In order to minimise the dust emissions during demolition, earth works, construction and track-out detailed in Table 10.13, a series of mitigation measures have been prepared in the form of a dust minimisation plan as recommended by the Institute of Air Quality Management *Guidance on the Assessment of Dust from Demolition and Construction*(21). The Dust Minimisation Plan will be reviewed at regular intervals during the construction phase 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.

While there is a high risk of dust soiling at the proposed development, in circumstances where the additional dust minimisation measures outlined in Appendix 10.2 are implemented and adhered to, the air quality impacts during the construction phase will be imperceptible, reversible and short-term.

Climate

There is the potential for a number of greenhouse gas emissions to the atmosphere during the construction phase of the development. Construction vehicles, generators etc., may give rise to CO_2 and N_2O emissions, however the IAQM guidance(21) states that experience of assessing the exhaust emissions from on-site plant and site traffic suggests that they are unlikely to make a significant impact on local air quality.

10.5.2 Operational Phase

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.

10.6 POTENTIAL CUMULATIVE IMPACTS

The proposed development is part of a wider masterplan for the development for the former Magee Barracks site which includes a permitted supermarket and proposed cancer treatment clinic, and a Phase 2 residential development.

With appropriate mitigation measures in place, the cumulative air quality effects of construction are not predicted to be significant.

The cumulative short- and long-term operational phase air quality effects of development are also not predicted to be significant. NOx and particulate emissions associated with the project arise due to additional traffic movements.

10.7 'DO NOTHING' IMPACT

The "Do Nothing" modelling assessment has been assessed under section 10.9.2. The assessment in this order was completed to facilitate calculation of the local air quality impact in accordance with the UK Design Manual for Roads and Bridges Methodology. It was found that all assessed pollutant concentrations were between 9% and 42% of their respective ambient air quality standards for the "Do Nothing" Scenario.

10.8 AVOIDANCE, REMEDIAL & MITIGATION MEASURES

In order to sufficiently ameliorate the likely air quality impacts, a schedule of air control measures has been formulated for both construction and operational phases associated with the proposed development.

10.8.1 Construction Phase

Air Quality

The greatest potential impact on air quality during the construction phase is from construction dust emissions, PM_{10}/$PM_{2.5}$ emissions and the potential for nuisance dust. Sensitive receptors which have the potential to be impacted by dust include the housing estates surrounding the site, and shops and businesses opposite the site entrance.

In order to minimise dust emissions during construction, a series of recommended mitigation measures have been prepared in the form of a dust minimisation plan (see Appendix 10.2). Due to the sensitivity of the current residential receptors adjacent to the site, additional mitigation measures recommended in the Institute of Air Quality Management *Guidance on the Assessment of Dust from Demolition and Construction* [21] for sensitive receptors have been included.

AQC CONST 1:	No development works shall take place before a dust minimisation plan has been prepared by the relevant appointed contractor(s) and approved by Kildare County Council. The approved dust minimisation plan shall be implemented and adhered to at all times by relevant contractor(s) and subcontractors unless otherwise agreed with Kildare County Council.

	The plan shall include, but not be limited to, measures such as: • Sweeping of hard-surfaces to remove mud and other materials. The use of un-surfaced roads shall be restricted to essential site traffic; • Watering of roads with potential to give rise to fugitive dust during dry and / or windy conditions; • Use of a wheel wash facility for vehicles entering onto public roads; • Speed restrictions on 20kph on un-surfaced roads, and on hard-surfaces as site management dictates; • Covering or enclosure of vehicles carrying material with dust potential; • Regular inspection and cleaning of public roads outside the site; • Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind; and • Water misting or sprays shall be used as required if particularly dusty activities are necessary during dry or windy periods.

At all times, these procedures 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.

Provided the dust minimisation measures outlined in the plan are adhered to, the air quality impacts during the construction phase will be imperceptible, reversible and short-term.

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 development. Construction vehicles, generators etc., may give rise to some CO_2 and N_2O emissions. However, due to short-term and temporary nature of these works, the impact on climate during the construction phase will be imperceptible and short-term.

However, some site-specific mitigation measures can be implemented during the construction phase of the proposed development to ensure emissions are reduced further. 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.

10.8.2 Operational Phase

Air Quality

Emissions of pollutants from road traffic can be controlled most effectively by either diverting traffic away from heavily congested areas or ensuring free flowing traffic through good traffic management plans and the use of automatic traffic control systems [12,13].

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

Improvements in air quality are likely over the next few years as a result of the on-going comprehensive vehicle inspection and maintenance program, fiscal measures to encourage the use of alternatively fuelled vehicles and the introduction of cleaner fuels.

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 development. Construction vehicles, generators etc., may give rise to some CO_2 and N_2O emissions. However, due to short-term and temporary nature of these works, the impact on climate air quality impacts during the operational phase will be imperceptible, reversible and long-term.

Nevertheless, some site-specific mitigation measures can be implemented during the construction phase of the proposed development to ensure emissions are reduced further. 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.

There is the potential for impacts, such as flooding, on the Magee Barracks due to Climate Change. In order to assess this, a site-specific flood risk assessment has been carried out and accompanies the planning application. Kildare County Development Plan 2017-2023 Strategic Flood Risk Assessment Report states that *‘ground water flooding is not a significant risk for Kildare’*. All existing information has been reviewed regarding flood risk in the location of the proposed development. We are fully satisfied, based on the available information, that the site of this proposed development is located in Flood Zone C (low risk) for all sources of flood risk.

10.9 PREDICTED IMPACTS OF THE PROPOSED DEVELOPMENT

10.9.1 Construction Phase

Air Quality

When the dust minimisation measures detailed in the mitigation section of this chapter are implemented, fugitive emissions of dust from the site will be insignificant at nearby receptors.

Climate

Due to the size and nature of the construction activities and assuming the appropriate mitigation measures are implemented, the impacts on climate from CO_2 and N_2O emissions during construction will be short-term and imperceptible.

10.9.2 Operational Phase

Local 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}.

Traffic flow information was obtained from Roadplan Consulting 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.

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(13). Firstly, background concentrations(18) have been included in the modelling study. These background concentrations are year-specific and account for non-localised sources of the pollutants of concern(17). Appropriate background levels were selected based on the available monitoring data provided by the EPA and Local Authorities(17,18) (see Section 10.3.3).

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 CO, benzene, NO_2, PM_{10} and $PM_{2.5}$ for the opening year 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 worst-case traffic data used in this assessment is shown in Table 10.14, with the percentage of HGVs shown in parenthesis. Three sensitive residential receptors and a medical centre 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 shown in Table 10.15 and Figure 10.2.

Table 10.14 Traffic Data used in this Assessment

Link	Road Name	Speed	Base Year	Do-Nothing		Do-Something	
			2019	2022	2037	2022	2037
1	R445 (East of junction)	50	4988 (3.2%)	5234 (3.3%)	6103 (0.033%)	6878 (2.1%)	8035 (0.02%)
2	R445 (West of junction)	50	5403 (2%)	5670 (2.2%)	6611 (0%)	8407 (1.2%)	9061 (0%)

Note: Traffic data expressed in AADT, percentage HGV shown in parenthesis

Table 10.15 Description of Sensitive Receptors (UTM Co-ordinates)

Name	Receptor Type	X	Y
R1	Medical Centre	640280	5891488
R2	Residential	640559	5891446
R3	Residential	640765	5891485
R4	Residential	640007	5891630

Fig. 10.2: Locations of sensitive receptors

Modelling Assessment

Transport Infrastructure Ireland Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes[(20)] 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. Therefore, in order to assess the impact of the scheme using the 'Do Something' modelling scenario, the 'Do Nothing' modelling scenario must first be assessed.

'Do Nothing' (DN) Scenario

NO_2

The results of the 'do nothing' assessment of annual average NO_2 concentrations in the opening and design years are shown in Table 10.16 for the Highways Agency IAN 170/12 and Table 10.17 using the UK Department for Environment, Food and Rural Affairs technique respectively. The purpose of IAN 170/12 was to account for the conclusions of UK's Department for Environment, Food and Rural Affairs advice on long term trends that there is now a gap between current projected vehicle emission reductions and projections on the annual rate of improvements in ambient air quality as previously published in UK Department for Environment, Food and Rural Affairs technical guidance and observed trends. Hence, the projections calculated via the IAN 170/12 technique show a slower than previously predicted reduction between the base year and future year predictions. The concentrations are below the limit value at all locations, with levels ranging up to 27% of the limit value in 2022 and 26% in 2037, using the more conservative IAN prediction.

The hourly limit value for NO_2 is 200 $\mu g/m^3$ 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 for the 'do nothing' scenario is not predicted to be exceeded in either 2022 or 2037 (Table 10.18).

PM_{10}

The results of the 'do nothing' modelling assessment for PM_{10} in the opening and design years are shown in Table 10.19. Concentrations are well within the annual limit value at all worst-case receptors. In addition, the 24-hour PM_{10} concentration of 50 $\mu g/m^3$, which can only be exceeded 35 times per year within the limit, is found to be in compliance at all receptors (Table 10.20). There are no days of exceedance predicted at any of the four receptors. Annual average PM_{10} concentrations are 40% of the limit value in 2022 and 2037.

$PM_{2.5}$

The results of the 'do nothing' modelling assessment for $PM_{2.5}$ in the opening and design years are shown in Table 10.21. The predicted concentrations at all worst-case receptors are well below the $PM_{2.5}$ limit value of 25 $\mu g/m^3$. The annual average $PM_{2.5}$ concentration peaks at 42% of the limit value in 2022 and 46% in 2037.

CO and Benzene

The results of the ‘do nothing’ modelling assessment for CO and benzene in the opening and design years are shown in Table 10.22 and Table 10.23. Concentrations are well within the limit values at all worst-case receptors. Levels of both pollutants are at maximum 9% and 5% of the respective limit values in 2022 and 2037.

‘Do Something’ (DS) Scenario

NO_2

The results of the assessment of the impact of the proposed development for NO_2 in the opening and design years are shown in Table 10.16 for the Highways Agency IAN 170/12 and Table 10.17 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 the UK Department for Environment, Food and Rural Affairs and more conservative IAN technique. Levels of NO_2 are 29% and 28% of the annual limit value in 2022 and 2037 using the IAN technique, while concentrations are 26% and 23% of the annual limit value in 2022 and 2037 using the UK Department for Environment, Food and Rural Affairs technique. Maximum one-hour NO_2 levels with the proposed development in place are not predicted to exceed using either technique. The impact of the proposed development on annual mean NO_2 levels can be assessed relative to ‘Do Nothing’ levels in 2022 and 2037. Relative to baseline levels, some small increases in pollutant levels are predicted as a result of the proposed development. With regard to impacts at individual receptors, none of the four receptors assessed will experience an increase in concentrations of over 2% of the limit value in 2022 and 2037. Thus, using the assessment criteria outlined in Table 10.2 to Table 10.4, the impact of the proposed development in terms of NO_2 is negligible at all of the receptors assessed.

The hourly limit value for NO_2 is 200 μg/m^3 is expressed as a 99.8th percentile (i.e. it must not be exceeded more than 18 times per year). The Maximum 1-hour NO_2 concentration for the “Do Something” scenario is not predicted to be exceeded in either 2022 and 2037 (Table 10.18).

PM_{10}

The results of the modelled impact of the proposed development for PM_{10} in the opening and design years are shown in Table 10.19. Predicted annual average concentrations in the region of the proposed development are below the ambient standards at all worst-case receptors with levels at 41% of the limit value in 2022. In addition, the 24-hour PM_{10} concentration of 50 μg/m^3, which can only be exceeded 35 times per year whilst remaining in compliance with the limit value, is found to be in compliance at all receptors. It is predicted that the worst-case receptors will have no exceedances of the 50 μg/m^3 24-hour mean value in 2022 and 2037 (Table 10.20). Future trends with the proposed development in place indicate similarly low levels of PM_{10}. Annual average PM_{10} concentrations are also 41% of the limit in 2037.

The impact of the proposed development can be assessed relative to ‘Do Nothing’ levels in 2022 and 2037 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. With regard to impacts at individual receptors, none of the four receptors assessed will experience an increase in concentrations of over

0.4% of the limit value in 2022 and 2037. Thus, the magnitude of the changes in air quality are imperceptible at all receptors based on the criteria outlined in Table 10.2 to Table 10.4.

The greatest impact on PM_{10} concentrations in the region of the proposed development in either 2022 or 2037 will be an increase of 0.6% of the annual limit value at Receptor 3. Thus, using the assessment criteria outlined in Table 10.2 and Table 10.3, the impact of the proposed development with regard to PM_{10} is negligible at all four of the receptors assessed.

$PM_{2.5}$

The results of the modelled impact of the proposed development for $PM_{2.5}$ in the opening and design years are shown in Table 10.21. Predicted annual average concentrations in the region of the proposed development are below the ambient standards at all worst-case receptors, with levels of 42% of the limit value in 2022. Future trends with the proposed development in place indicate similarly low levels of $PM_{2.5}$. Annual average $PM_{2.5}$ concentrations are also 42% of the limit in 2037.

The impact of the proposed development can be assessed relative to 'Do Nothing' levels in 2022 and 2037. 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 four receptors assessed will experience an increase or decrease in concentrations of over 0.42% of the limit value in 2022 and 2037. Thus, the magnitude of the changes in air quality is negligible at all receptors based on the criteria outlined in Table 10.2 and Table 10.3.

CO and Benzene

The results of the modelled impact of the scheme for CO and benzene in the opening and design years are shown in Table 10.22 and Table 10.23 respectively. Predicted pollutant concentrations with the proposed development in place are below the ambient standards at all locations. Levels of both pollutants range from 9% to 5% of the respective limit values in 2022 and 2037. Future trends indicate similarly low levels of CO and benzene.

The impact of the proposed development can be assessed relative to "Do Nothing" levels in 2022 and 2037. 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 in either 2022 or 2037 will be an increase of 0.55% of their respective limit values at Receptor 4. Thus, using the assessment criteria for NO_2 and PM_{10} and applying these criteria to CO and benzene, the impact of the proposed development in terms of CO and benzene is negligible.

Table 10.16 Annual Mean NO_2 Concentrations ($\mu g/m^3$) (using Interim advice note 170/12 V3 Long Term NO_2 Trend Projections)

Receptor	Impact Opening Year (2022)					Impact Design Year (2037)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	10.4	10.8	0.38	Imperceptible	Negligible Increase	10.0	10.5	0.48	Small	Negligible Increase
2	10.6	11.0	0.45	Small	Negligible Increase	10.2	10.7	0.54	Small	Negligible Increase
3	10.7	11.2	0.49	Small	Negligible Increase	10.4	11.0	0.61	Small	Negligible Increase
4	10.8	11.6	0.80	Small	Negligible Increase	10.5	11.2	0.76	Small	Negligible Increase

Table 10.17 Annual Mean NO_2 Concentrations ($\mu g/m^3$) (using UK Department for Environment, Food and Rural Affairs Technical Guidance)

Receptor	Impact Opening Year (2022)					Impact Design Year (2037)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	9.3	9.6	0.34	Imperceptible	Negligible Increase	8.1	8.5	0.39	Imperceptible	Negligible Increase
2	9.5	9.9	0.40	Small	Negligible Increase	8.3	8.8	0.44	Small	Negligible Increase
3	9.6	10.0	0.44	Small	Negligible Increase	8.5	9.0	0.50	Small	Negligible Increase
4	9.7	10.4	0.72	Small	Negligible Increase	8.6	9.2	0.62	Small	Negligible Increase

Table 10.18 99.8th Percentile of Daily Maximum 1-hour for NO_2 Concentrations ($\mu g/m^3$)

Receptor	IAN 170/12 V3 Long Term NO_2 Trend Projections Technique				Defra's Technical Guidance Technique			
	Impact Opening Year (2022)		Impact Design Year (2037)		Impact Opening Year (2022)		Impact Design Year (2037)	
	DN	DS	DN	DS	DN	DS	DN	DS
1	36.5	37.8	35.0	36.7	36.5	37.8	35.0	36.7
2	37.0	38.6	35.7	37.6	37.0	38.6	35.7	37.6
3	37.6	39.3	36.3	38.4	37.6	39.3	36.3	38.4
4	37.9	40.7	36.6	39.3	37.9	40.7	36.6	39.3

Table 10.19 Annual Mean PM_{10} Concentrations ($\mu g/m^3$)

Receptor	Impact Opening Year (2022)					Impact Design Year (2037)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	16.0	16.0	0.07	Imperceptible	Negligible Increase	16.0	16.1	0.09	Imperceptible	Negligible Increase
2	16.0	16.1	0.08	Imperceptible	Negligible Increase	16.0	16.1	0.10	Imperceptible	Negligible Increase
3	16.0	16.1	0.10	Imperceptible	Negligible Increase	16.1	16.2	0.11	Imperceptible	Negligible Increase
4	16.1	16.2	0.16	Imperceptible	Negligible Increase	16.1	16.3	0.15	Imperceptible	Negligible Increase

Table 10.20 Number of Days with PM_{10} Concentration > 50 µg/m³

Receptor	Impact Opening Year (2022)		Impact Design Year (2037)	
	DN	DS	DN	DS
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0

Table 10.21 $PM_{2.5}$ Annual Mean $PM_{2.5}$ Concentrations (µg/m³)

Receptor	Impact Opening Year (2022)					Impact Design Year (2037)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	10.4	10.4	0.05	Imperceptible	Negligible Increase	10.4	10.5	0.06	Imperceptible	Negligible Increase
2	10.4	10.4	0.06	Imperceptible	Negligible Increase	10.4	10.5	0.07	Imperceptible	Negligible Increase
3	10.4	10.5	0.06	Imperceptible	Negligible Increase	10.4	10.5	0.07	Imperceptible	Negligible Increase
4	10.4	10.5	0.11	Imperceptible	Negligible Increase	10.5	10.6	0.10	Imperceptible	Negligible Increase

Table 10.22 Maximum 8-hour CO Concentrations (mg/m³)

Receptor	Impact Opening Year (2022)					Impact Design Year (2037)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	0.83	0.85	0.024	Imperceptible	Negligible Increase	0.84	0.87	0.029	Imperceptible	Negligible Increase
2	0.84	0.87	0.028	Imperceptible	Negligible Increase	0.85	0.89	0.033	Imperceptible	Negligible Increase
3	0.85	0.88	0.031	Imperceptible	Negligible Increase	0.87	0.90	0.037	Imperceptible	Negligible Increase
4	0.86	0.92	0.055	Imperceptible	Negligible Increase	0.88	0.93	0.049	Imperceptible	Negligible Increase

Table 10.23 Annual Mean Benzene Concentrations (µg/m³)

Receptor	Impact Opening Year (2022)					Impact Design Year (2037)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	0.22	0.22	0.006	Imperceptible	Negligible Increase	0.22	0.23	0.007	Imperceptible	Negligible Increase
2	0.22	0.23	0.007	Imperceptible	Negligible Increase	0.22	0.23	0.008	Imperceptible	Negligible Increase
3	0.22	0.23	0.007	Imperceptible	Negligible Increase	0.23	0.24	0.009	Imperceptible	Negligible Increase
4	0.23	0.24	0.013	Imperceptible	Negligible Increase	0.23	0.24	0.012	Imperceptible	Negligible Increase

Table 10.24 Regional Air Quality Assessment

Year	Scenario	VOC (kg/annum)	NOX (kg/annum)	CO_2 (tonnes/annum)
2032	Do Nothing	224	634	385
	Do Something	307	819	522
2037	Do Nothing	244	595	410
	Do Something	342	912	583
Increment in 2020		83 kg	184.5 kg	136.6 Tonnes
Increment in 2030		97.3 kg	317.7 kg	173 Tonnes
Emission Ceiling (kilo Tonnes) 2020		**57** Note 1	**66** Note 1	37,943 Note 2
Emission Ceiling (kilo Tonnes) 2030		**51** Note 1	**40** Note 1	26,800 Note 3
Impact in 2020 (%)		0.00015%	0.00028%	0.00036%
Impact in 2030 (%)		0.00016%	0.00046%	0.00051%

Note 1 Targets under the "*Proposal for a Directive on the reduction of national emissions of certain atmospheric pollutants and amending Directive 2003/35/EC*"

Note 2 20-20-20 Climate and Energy Package

Note 3 REGULATION (EU) 2018/842 which sets the binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013

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. 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 (27).

The regional impact of the proposed development on emissions of NO_x and VOCs has been assessed using the procedures of Transport Infrastructure Ireland(20) and the UK Department for Environment, Food and Rural Affairs(12). The results (see Table 10.24 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 assessment year of 2022, the predicted impact of the changes in AADT is to increase NO_x levels by 0.00028% of the NO_x emissions ceiling and increase VOC levels by 0.00015% of the VOC emissions ceiling to be complied with in 2020. For the assessment year of 2037, the predicted impact of the changes in AADT is to increase NO_x levels by 0.00046% of the NO_x emissions ceiling and increase VOC levels by 0.00016% of the VOC emissions ceiling to be complied with in 2035.

Regional Climate Impacts

The regional impact of the proposed development on emissions of CO_2 was also assessed using the Design Manual for Roads and Bridges screening model (see Table 10.24). The results show that the impact of the proposed development in 2022 will be to increase CO_2 emissions by 0.00036% of Ireland's EU 2020(27) Target. In the design year of 2037, the proposed development will increase CO_2 emissions by 0.00051% of Ireland's 2030 (28) emissions Target. 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 or 2030 Targets.

Therefore, the likely overall magnitude of the changes on climate in the operational stage is imperceptible and long-term.

10.10 MONITORING

During the construction stage of the project dust emissions from site activities will have the greatest impact on air quality. AWN recommend that monitoring of dust deposition levels (via the Bergerhoff method) takes place at a number of locations at the site boundary of the proposed development to ensure that dust nuisance is not occurring at nearby sensitive receptors. This methodology will ensure that the dust mitigation measures outlined in the dust minimisation plan (Appendix 10.2) remain effective. As climate impacts during the construction stage are negligible, there is no monitoring necessary.

Impacts in relation to air quality and climate during the operational stage of the project are negligible and imperceptible; therefore, there is no monitoring necessary during the operational stage of the project for either air quality or climate.

10.11 REINSTATEMENT

This is not applicable to the Air Quality and Climate assessment.

10.12 INTERACTIONS

Air Quality does not have a significant number of interactions with other chapters. The most significant interactions are between Population and Human Health and Air Quality. An adverse impact due to air quality in either the construction or operational phases has the potential to cause health and dust nuisance issues. The mitigation measures that will be put in place for the development will ensure that the impact of the development complies with all ambient air quality legislative limit values and therefore the predicted impact is long term and imperceptible with respect to human beings.

Interactions between Air Quality and traffic are important. With increased traffic movements and reduced engine efficiency, i.e. due to congestion, the emissions of vehicles increase. How the proposed development may impact on air quality is assessed by reviewing the change in annual average daily traffic on roads close to the site. In this assessment the impact of the interactions between traffic and air quality are not significant.

The construction and operation of the proposed development may lead to increased traffic emissions to atmosphere which have the potential to impact on flora, fauna and water, however no designated area of conservation (either Irish or European designation) are within 2 km of the proposed site. Therefore, the effect of these emissions is predicted to be neutral for both the construction and operational phase. Construction and operational phase mitigation measures will minimise dust emissions which have the potential to impact on flora, fauna and water.

10.13 DIFFICULTIES ENCOUNTERED IN COMPILING

There were no difficulties encountered in compiling this assessment.

10.14 REFERENCES

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(4) Framework Convention on Climate Change (1997) Kyoto Protocol To The United Nations Framework Convention On Climate Change
(5) UNFCCC (2012) Doha Amendment To The Kyoto Protocol European Commission (2014) A policy framework for climate and energy in the period from 2020 to 2030
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(10) EPA (2002 & 2017) Guidelines On Information To Be Contained in Environmental Impact Statements
(11) EPA (2003 & 2015) Advice Notes On Current Practice (In The Preparation Of Environmental Impact Statements)
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(15) UK Highways Agency (2007) Design Manual for Roads and Bridges Vol 11 Chapter 3, HA 207/07 (Document & Calculation Spreadsheet)
(16) UK DEFRA (2001) DMRB Model Validation for the Purposes of Review and Assessment
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(18) Environmental Protection Agency (2018) Air Quality Monitoring Report 2017 (& previous annual reports 1997-2016)
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(21) IAQM (2014) Guidance on the Assessment of Dust from Demolition and Construction Version 1.1
(22) Transport Infrastructure Ireland (2009) Guidelines for Assessment of Ecological Impacts of National Roads Schemes (Rev. 2, Transport Infrastructure Ireland, 2009)
(23) Department of the Environment, Heritage and Local Government (2010) Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities
(24) World Health Organisation (2006) Air Quality Guidelines – Global Updates 2005 (and previous Air Quality Guidelines Reports 1999 & 2000)
(25) UK DEFRA (2011) Trends in NOx and NO2 emissions and ambient measurements in the UK
(26) UK Highways Agency (2012) Interim Advice Note 170/12 Updated air quality advice on the assessment of future NOx and NO_2 projections for users of DMRB Volume 11, Section 3, Part 1 'Air Quality
(27) EU (2017) 2017/1471 amending Decision 2013/162/EU to revise Member States' annual emission allocations for the period from 2017 to 2020
(28) EU (2014) EU 2030 Climate and Energy Framework

APPENDIX 10.1

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) (see Table 10.1 - 10.2). 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. Council Directive 1999/30/EC, as relating to limit values for sulphur dioxide, nitrogen dioxide, lead and particulate matter, is detailed in Table 10.1. 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 will start 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 as set out in Table 10.1. 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 $PM_{2.5}$ is 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 has been 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(14). 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(15) 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(16).

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 (15).

APPENDIX 10.2 DUST MINIMISATION PLAN

A dust minimisation plan will be formulated for the construction phase of the project, as construction activities are likely to generate some dust emissions. The potential for dust to be emitted depends on the type of construction activity being carried out in conjunction with environmental factors including levels of rainfall, wind speeds and wind direction. The potential for impact from dust depends on the distance to potentially sensitive locations and whether the wind can carry the dust to these locations. The majority of any dust produced will be deposited close to the potential source and any impacts from dust deposition will typically be within two hundred metres of the construction area. Below are the highly recommended Dust Mitigation measures as per IAQM Guidance.

Communications

- Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.
- Display the name and contact details of person accountable for air quality and dust issues on the site boundary.
- Display the head or regional office contact information.
- Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority. The level of detail will depend on the risk and should include as a minimum the highly recommended measures in this document. The desirable measures should be included as appropriate for the site. The DMP may include monitoring of dust deposition, dust flux, real-time PM_{10} continuous monitoring and/or visual inspections.

Site Management

- Regular inspections of the site and boundary should be carried out to monitor dust, records and notes on these inspections should be logged.
- Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.
- Make the complaints log available to the local authority when asked.
- Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book.
- Hold regular liaison meetings with other high risk construction sites within 500 m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/deliveries which might be using the same strategic road network routes.

Monitoring

- Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100 m of site boundary, with cleaning to be provided if necessary.
- Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities

with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.

- Agree dust deposition, dust flux, or real-time PM_{10} continuous monitoring locations with the Local Authority. Where possible commence baseline monitoring at least three months before work commences on site or before work on a phase commences. Further guidance is provided by IAQM on monitoring during demolition, earthworks and construction.

Preparing and Maintaining the Site

- Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.
- Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.
- Fully enclose specific operations where there is a high potential for dust production and the site is active for an extensive period.
- Avoid site runoff of water or mud.
- Keep site fencing, barriers and scaffolding clean using wet methods.
- Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below.
- Cover, seed or fence stockpiles to prevent wind whipping.

Operating Vehicles / Machinery and Sustainable Travel

- Ensure all vehicles switch off engines when stationary - no idling vehicles.
- Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable.
- Impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate).
- Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.
- Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing)

Operations

- Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.
- Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.
- Use enclosed chutes and conveyors and covered skips.
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
- Ensure equipment is readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.

Waste Management

- Avoid bonfires and burning of waste materials.

Measures Specific to Demolition

- Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).
- Ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition, high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground.
- Avoid explosive blasting, using appropriate manual or mechanical alternatives.
- Bag and remove any biological debris or damp down such material before demolition.

Measures Specific to Earthworks

- Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.
- Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.
- Only remove the cover in small areas during work and not all at once.
- During dry and windy periods, and when there is a likelihood of dust nuisance, a bowser will operate to ensure moisture content is high enough to increase the stability of the soil and thus suppress dust.

Measures Specific to Construction

- Avoid scabbling (roughening of concrete surfaces) if possible.
- Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.
- Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.
- For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust.

Measures Specific to Trackout

Site roads (particularly unpaved) can be a significant source of fugitive dust from construction sites 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%.

- A speed restriction of 20 km/hr will be applied as an effective control measure for dust for on-site vehicles.

- Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use.
- Avoid dry sweeping of large areas.
- Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
- Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.
- Record all inspections of haul routes and any subsequent action in a site log book.
- Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.
- Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).
- Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.
- Access gates to be located at least 10 m from receptors where possible.