Chapter 9:

Air Quality and Climate

9.0 AIR QUALITY & CLIMATE

9.1 INTRODUCTION

Byrne Environmental Consulting Ltd have assessed the potential air quality and climatic impacts that the proposed development in Dunshaughlin, Co. Meath may have on the receiving environment during the construction and operational phases of the project. The assessment includes a comprehensive description of the existing air quality in the vicinity of the subject site, a description and assessment of how construction activities and the operation of the development may impact existing air quality, the mitigation measures that will be implemented to control and minimise the impact that the development may have on local ambient air quality and reduce the impact on the local micro climate and finally to demonstrate how the development shall be constructed and operated in an environmentally sustainable manner.

The proposed development consists of a strategic housing development comprising of 913 no. residential units, a neighbourhood centre, including 2 no. retail units, a café / restaurant unit, a primary healthcare / gym, a community facility and a childcare facility, all associated open space, a section of the Outer Relief Road, internal roads, cycle and pedestrian infrastructure, services and all other associated development on a site of c. 28.3 hectares.

The 913 no. residential units proposed consist of 505 no. houses (single, two, and three storey), 186 no. duplex units (three storey), and 222 no. apartments (four and five storey).

The proposed neighbourhood centre facilities consist of a childcare facility with a GFA of 1,282 sq.m, a community facility with a GFA of 180 sq.m, 2 no. retail units with GFA of 1,000 sq.m and 190 sq.m, a café / restaurant unit with a GFA of 370 sq.m, and a primary healthcare / gym unit with a GFA of 1,040 sq.m.

The development also includes car and cycle parking, ESB substations, boundary treatment, foul and surface water drainage, attenuation tanks, other services and all other associated development.

This Chapter of the EIAR includes a comprehensive description of the existing air quality and climate at and in the vicinity of the subject site, a description of how the construction and operational phases of the development may impact existing air quality and finally; the mitigation measures that shall be implemented to control and minimise the impact that the development may have on local ambient air quality and reduce the impact on the local micro climate.

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9.2 STUDY METHODOLOGY

The general assessment methodology of the potential impact of the proposed development on air quality and climate has been conducted in accordance with:

- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (DoHPLG, August 2018).
- 2017 EPA Draft Guidelines on information to be contained in Environmental Impact Assessment Reports.
- Guidelines on Information to be Contained in an Environmental Impact Statement (EPA 2002).

- Advice Notes on Current Practice (in preparation of Environmental Impact Statements) (EPA 2003).

- Environmental Protection Agency, 2015. Revised Guidelines on the Information to be Contained in Environmental Impact Statements.

- European Union (Planning & Development)(Environmental Impact Assessment) Regulations 2018 (SI No. 296 of 2018).

- Environmental Impact Assessment of Projects – Guidance on the preparation of the EIAR, European Commission, 2017.

9.2.1 Air Quality Assessment Methodology

Baseline Environment
The existing ambient air quality in the vicinity of the site has been characterised with information obtained from a number of sources as follows:

- Environmental Protection Agency's Annual Air Quality in Ireland 2017 Report
- Site specific air quality monitoring surveys at site boundaries

The ambient air quality data collected and reviewed for the purpose of this study focused on the principal substances (dust, vehicle exhaust emissions and boiler emissions) which may be released from the site during the construction and operation phases and which may exert an influence on local air quality.

Impact Assessment Methodology

Legislation and guidance
Air quality standards and guidelines are available from a number of sources. The guidelines and standards referenced in this report include those from Ireland and the European Union.

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 (Ref Table 9.1).

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 National Air Quality Standards Regulations 2011 (S.I No. 180 of 2011), which incorporate European Commission Directive 2008/50/EC which has set limit values for the pollutants SO2, NO2, PM10, benzene and CO 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). Provisions are also made for the inclusion of new ambient limit values relating to $PM_{2.5.}$

The European 2008/50/EC Clean Air For Europe (CAFÉ) Directive is the current air quality directive for Europe which supersedes the European Directives 1999/30/EC and 2000/69/EC.

In order to assess a wider range of air pollutants in the development area it is necessary to review current air quality monitoring data from published sources such as the most recent EPA's 2017 Annual report entitled Air Quality in Ireland. This EPA report provides detailed monitoring data collected from a number of monitoring locations throughout Ireland on an annual basis to assess national compliance with National Air Quality Regulations. Given the location of the site in Dunshaughlin, County Meath, it is characterised as a Zone D area as defined by the EPA.

EU legislation on air quality requires that Member States divide their territory into zones for the assessment and management of air quality. The zones in place in Ireland in 2017 are as follows:

Zone A is the Dublin conurbation,
Zone B is the Cork conurbation
Zone C comprising 23 large towns in Ireland with a population >15,000.
Zone D is the remaining area of Ireland.

The air quality in each zone is assessed and classified with respect to upper and lower assessment thresholds based on measurements over the previous five years. Upper and lower assessment thresholds are prescribed in the legislation for each pollutant. The number of monitoring locations required is dependent on population size and whether ambient air quality concentrations exceed the upper assessment threshold, are between the upper and lower assessment thresholds, or are below the lower assessment threshold. A summary of the EPA's Annual report entitled Air Quality in Ireland 2017 is detailed below in Table 9.2.

Table 9.1 Air Quality Standards Regulations 2011 (based on EU Council Directive 2008/50/EC)

POLLUTANT	REGULATION	LIMIT CRITERIA	TOLERANCE	LIMIT VALUE
NITROGEN DIOXIDE	2008/50/EC	Hourly limit for the protection of human health – not to be exceeded more than 18 times/year	40% until 2003 reducing linearly to 0% by 2010	200 µg/m^3
		Annual limit for the protection of human health	40% until 2003 reducing linearly to 0% by 2010	40 µg/m^3
		Annual limit for the protection of vegetation	None	400 µg/m^3 NO & NO_2
LEAD	2008/50/EC	Annual limit for the protection of human health	100%	0.5 µg/m^3
SULPHUR DIOXIDE	2008/50/EC	Hourly limit for protection of human health – not to be exceeded more than 24 times/year	150 µg/m^3	350 µg/m^3
		Daily limit for protection of human health – not to be exceeded more than 3 times/year	NONE	125 µg/m^3
		Annual and Winter limit for the protection of ecosystems	NONE	20 µg/m^3
PARTICULATE MATTER PM10	2008/50/EC	24-hour limit for protection of human health – not to be exceeded more than 35 times/year	50%	50 µg/m^3
		Annual limit for the protection of human health	20%	40 µg/m^3
PARTICULATE MATTER PM2.5 STAGE 1	2008/50/EC	Annual limit for the protection of human health	20% from June 2008. Decreasing linearly to 0% by 2015	25 µg/m^3
PARTICULATE MATTER PM2.5 STAGE 2	2008/50/EC	Annual limit for the protection of human health	NONE	20 µg/m^3

BENZENE	2008/50/EC	Annual limit for the protection of human health	20% until 2006. Decreasing linearly to 0% by 2010	5 µg/m^3
CARBON MONOXIDE	2008/50/EC	8-hour limit (on a rolling basis) for protection of human health	60%	10 mg/m^3
DUST DEPOSITION	German TA Luft Air Quality Standard Note 1	30 Day Average	NONE	350 mg/m^2/day

Note 1 Dust levels in urban atmospheres can be influenced by industrial activities and transport sources. There are currently no national or European Union air quality standards with which these levels of dust deposition can be compared. However, a figure of 350 mg/m^2-day (as measured using Bergerhoff type dust deposit gauges as per German Standard Method for determination of dust deposition rate, *VDI 2129*) is commonly applied to ensure that no nuisance effects will result from industrial or construction activities.

Table 9.2 EPA 2016 Assessment Zone Classification

Pollutant	EPA 2016 Assessment Classification
NO_2	
Zone A & B	Above lower assessment threshold
Zone C & D	Below lower assessment threshold
SO_2	
Zone A & B	Below lower assessment threshold
Zone C & D	Below lower assessment threshold
CO	
Zone A & B	Below lower assessment threshold
Zone C & D	Below lower assessment threshold
Ozone	
Zone A & B	Below long term objective
Zone C & D	Above long term objective
PM_{10}	
Zone A & B & C	Above lower assessment threshold
Zone D	Below lower assessment threshold
$PM_{2.5}$	
Zone A & B	Below lower assessment threshold
Zone C & D	Above lower assessment threshold
Benzene	
Zone A & B	Below lower assessment threshold
Zone C & D	Below lower assessment threshold
Heavy Metals (As, Ni, Cd, Pb)	
Zone A & B	Below lower assessment threshold
Zone C & D	Below lower assessment threshold
Poly Aromatic Hydrocarbons (PAH)	
Zone A & C & D	Above lower assessment threshold
Zone B	Above upper assessment threshold

Construction Impact Assessment Criteria

Transport Infrastructure Ireland's (formally the NRA) 'Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes' (Revision 1, 2011) states that "*it is very difficult to accurately quantify dust emissions arising from construction activities*" and that "*it is thus not possible to easily predict changes to dust soiling rates or PM_{10} concentrations.*" The guidance advises the use of a semi-quantitative

approach to determine the likelihood of a significant impact which should be combined with an assessment of the proposed mitigation measures.

The construction assessment criteria, reproduced from the TII (formerly NRA) guidance, are set out in Table 9.3 below.

Table 9.3 Assessment criteria for the impact of duct emissions from construction activities with standard mitigation in place (NRA, 2011)

Source		Potential distance for significant effects (distance from source)		
Scale	**Description**	**Soiling**	**PM_{10} [a]**	**Vegetation effects**
Major	Large construction sites, with high use of haul routes	100m	25m	25m
Moderate	Moderate sized construction sites, with moderate use of haul routes	50m	15m	15m
Minor	Minor construction sites, with limited use of haul routes	25m	10m	10m

The impact of construction related dust emissions is assessed by estimating the area over which there is a risk of significant impacts as per the NRA guidance. The significance of impact is assessed in terms of the significance criteria outline in the EPA's 2017 Guidelines on the information to be contained in Environmental Impact Assessment Reports.

In relation to construction related traffic, air quality significance criteria are assessed on the basis of compliance with the appropriate standards air limit values. The Air Quality Standards Regulations 2011 replace the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002), the Ozone in Ambient Air Regulations 2004 (S.I. No. 53 of 2004) and S.I. No. 33 of 1999.

Operational Impact Assessment Criteria

Once operational, the proposed Dunshaughlin residential development may impact on air quality as a result of the requirements of new buildings to be heated and with the increased traffic movements associated with the development.

Air quality significance criteria are assessed on the basis of compliance with the national air quality limit values. The Air Quality Standards Regulations 2011 replace the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002), the Ozone in Ambient Air Regulations 2004 (S.I. No. 53 of 2004) and S.I. No. 33 of 1999.

9.2.2 Climate Assessment Methodology

Climate has implications for many aspects of the environment from soils to biodiversity and land use practices. The proposed development may impact on both the macro-climate and micro-climate. The macro-climate is the climate of a large geographic area such as Ireland. The micro-climate refers to the climate in the immediate area.

With respect to microclimate, green areas are considered to be sensitive to development. Development of any green area is generally associated with a reduction in the abundance of vegetation including trees and a reduction in the amount of open, undeveloped space. The removal of vegetation or the development of man-made structures in these areas can intensify the temperature gradient.

To assess the impacts of converting vegetative surfaces to hard-standing with residential buildings and its significance, the amount of vegetative surfaces associated with the proposed development that will be converted to residential buildings and hard-standing has been considered.

The impact of the proposed scheme upon the macro-climate is assessed through the consideration of the change in CO_2 emissions that will occur due to the changes in traffic flow that occur in response to the proposed scheme.

The most recent Conference of the Parties to the Convention (COP23) occurred in November 2017 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", agreed by 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 has also been made on elevating adaption onto the same level as action to cut and curb emissions.T he EU, on the 23/24th of October 2014, agreed the "2030 Climate and Energy Policy Framework" (EU, 2014). The European Council endorsed a binding EU target of at least a 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990. The target will be delivered collectively by the EU in the most cost-effective manner possible, with the reductions in the ETS and non-ETS sectors amounting to 43% and 30% by 2030 compared to 2005, respectively. Secondly, it was agreed that all Member States will participate in this effort, balancing considerations of fairness and solidarity. The policy also outlines, under "Renewables and Energy Efficiency", an EU binding target of at least 27% for the share of renewable energy consumed in the EU in 2030.

European Commission Directive 2001/81/EC, the National Emissions Ceiling Directive (NECD) (2014), prescribes the same emission limits as the 1999 Gothenburg Protocol. A National Programme for the progressive reduction of emissions of these four transboundary pollutants has been in place since April 2005 (DEHLG, 2007a; 2004). Data available from the EU in 2010 indicated that Ireland complied with the emissions ceilings for SO2, VOCs and NH3 but failed to comply with the ceiling for NOX (EEA, 2012). 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 SO2, NOX, NMVOC, NH3, PM2.5 and CH4. In relation to Ireland, 2020-29 emission targets are for SO2 (65% below 2005 levels), for NOX (49% reduction), for VOCs (25% reduction), for NH3 (1% reduction) and for PM2.5 (18% reduction). In relation to 2030, Ireland's emission targets are for SO2 (85% below 2005 levels), for NOX (69% reduction), for VOCs (32% reduction), for NH3 (5% reduction) and for PM2.5 (41% reduction).

The following guidelines and EU Directives relating to Climate Change aspects of EIA reports have been applied to this assessment in order to determine the potential impacts that the proposed development may have an climate change.

2017 EPA Draft Guidelines on information to be contained in Environmental Impact Assessment Reports.

European Union (Planning & Development)(Environmental Impact Assessment) Regulations 2018 (SI No. 296 of 2018).

European EIA Directive 2014/52/EU

The Irish Building Regulations *Technical Guidance Document L – Conservation of Fuel & Energy – Dwellings* amended in 2017 includes requirements for all residential dwellings to be "Nearly Zero Energy Buildings" (NZEB's) by 31st December 2020.

9.3 EXISTING RECEIVING ENVIRONMENT

9.3.1 Description of the baseline environment

The site is located on the outskirts of Dunshaughlin town and is accessed off the R147 Regional Road between Dublin and Navan and is located approximately 1km east of the M3 Motorway. The Dunshaughlin Business Park is located to the west of the site boundary. Existing residential development borders the northern and north-western western site boundaries. The subject application site adjoins Phase 1A – 1C of the under construction and partially occupied residential development site (The Willow's) which is under the Applicant's land ownership.

The development area is located within a zone which includes sources of transportation related air emissions principally from the R147, the M3 Motorway and local road infrastructure and sources of domestic, retail and commercial building heating. The Dunshaughlin Business Park does not include any large facilities that generate industrial emissions. It is noted that there are no major sources of industrial air emissions within 7km of the site. The Shire Pharmaceuticals facility in North Dunboyne is currently under construction and is located approximately 7km south of the site and the Damastown Industrial Park, part of the Dublin Enterprise Zone focused on Dublin 15, is located approximately 14km south of the site.

9.3.2 Description of Existing Climate

The nearest representative synoptic meteorological station to the subject site is at Dublin Airport which is located approximately 18km south east of the site and as such, long-term measurements of wind speed/direction and air temperature for this location are representative of prevailing conditions experienced at the subject site. Recent meteorological data sets for Dublin Airport were obtained from Met Éireann for the purposes of this assessment study.

Rainfall

Precipitation data from the Dublin Airport meteorological station for the period 2011-2017 indicates a mean annual total of about 762 mm. This is within the expected range for most of the eastern half of the Ireland which has between 750 mm and 1000 mm of rainfall in the year.

Temperature

The annual mean temperature at Dublin Airport (2011-2017) is 9.5ºC with a mean maximum of 15.3ºC and a mean minimum of 4.0ºC. Given the relative close proximity of this meteorological station to the proposed development site, similar conditions would be observed. Table 9.4 sets out meteorological data for Dublin Airport from 2011-2017.

Table 9.4 Meteorological Data for Dublin Airport 2011-2017

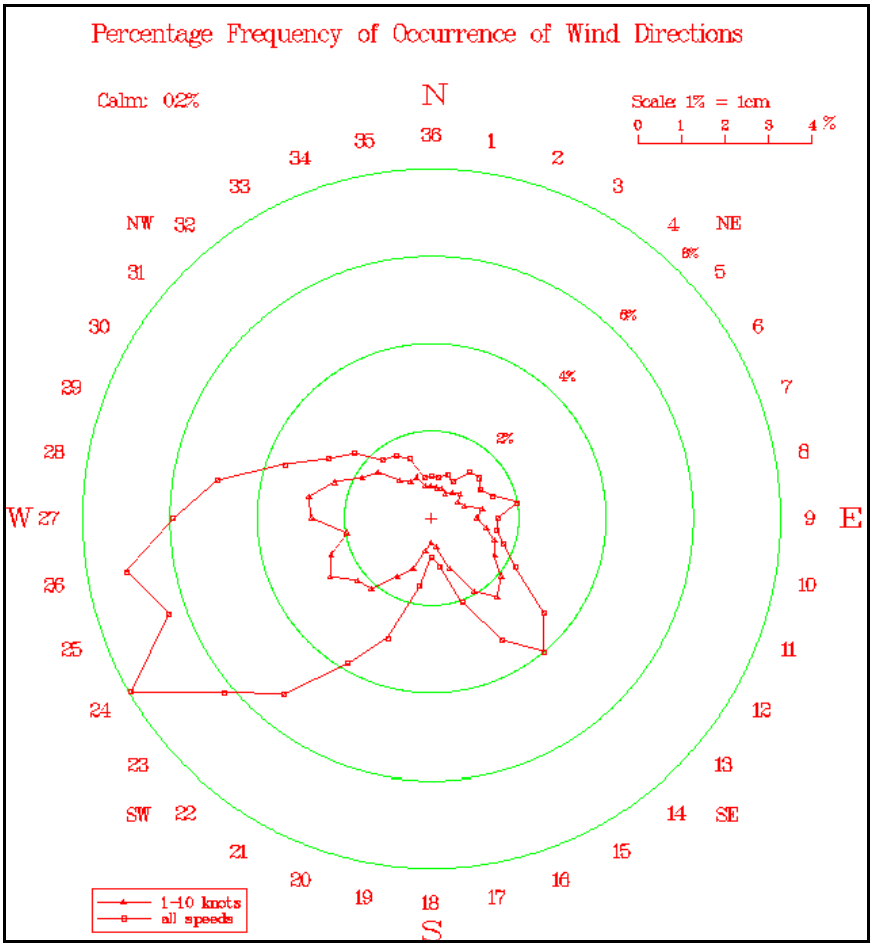
Year	Period	Rainfall (mm)	Maximum mean Temperature (^{0}C)	Minimum mean Temperature (^{0}C)	Mean Temperature (^{0}C)
2011	Annual Mean	672	16.7	3.1	9.4
2012	Annual Mean	850	15.3	5.4	9.3
2013	Annual Mean	764	14.0	3.6	9.9
2014	Annual Mean	870	15.8	5.4	10.6
2015	Annual Mean	766	14.0	4.0	9.0
2016	Annual Mean	725	15.7	4.4	10.1
2017	Annual Mean	661	15.0	5.3	9.9
Mean		762	15.3	4.0	9.5

Note 1: Data supplied by Met Eireann

Wind

Wind is of key importance for both the generation and dispersal of air pollutants. Meteorological data for Dublin Airport indicates that the prevailing wind direction, in the Dublin area, is from the West and Southwest and blows Northeast across the proposed development. The mean annual wind speed in the Dublin area between 2009 - 2017 is 5.7 m/s.

Figure 9.1 Windrose for Dublin Airport



9.3.3 Description of existing air quality

The existing ambient air quality at and in the vicinity of the site is typical of an out of city urban location and as such, domestic and commercial heating sources and road traffic are identified as the dominant contributors of hydrocarbon, combustion gases and particulate emissions to ambient air quality.

Trends in air quality

Annual air quality monitoring programs have been undertaken in recent years by the EPA and Local Authorities. The most recent annual report on air quality "Air Quality in Ireland 2017– Key Indicators of Ambient Air Quality" details the range and scope of monitoring undertaken throughout Ireland with Dunshaughlin categorised as Zone D.

The most recent 2017 EPA publication includes a number of Zone D monitoring locations which would be broadly comparable to the expected air quality at the subject site. The various Zone D air quality monitoring stations within Ireland provide a comprehensive range of air quality monitoring data sets which have been selected as part of this assessment to describe the existing ambient air quality at the subject site.

Nitrogen Dioxide

The Air Quality Standards Regulations 2011 specify a limit value of 40 µg/m^3, for the protection of human health, over a calendar year. The standard, taken from the 2008 CAFÉ Directive 2000/69/EC, came into force in 2011.

Long term NO_2 monitoring was carried out at three Zone D locations in 2017. The NO_2 annual mean in 2017 for these sites ranged from 2.3 -7.4 µg/m^3. Therefore, long term averages were below the annual average limit of 40 µg/m^3.

Sulphur Dioxide

The Air Quality Standards Regulations 2011 specify a daily limit value of 125 µg/m3 for the protection of human health. The standard, taken from the 2008 CAFÉ Directive 2000/69/EC, came into force in 2011.

Long term SO_2 monitoring was carried out at two Zone D locations in 2017. The daily SO_2 daily means in 2017 for these sites ranged from 2.7 – 4.1 µg/m^3. Therefore, long term averages were significantly below the daily limit of 125 µg/m^3.

The annual mean SO_2 concentrations in Ireland have being slightly declining since 2003. This trend is reflective in the shift in fuel choice across Ireland in both residential heating and the energy production sector.

Carbon Monoxide

The Air Quality Standards Regulations 2011 specify an 8-hour limit value (on a rolling basis) for the protection of human health of 10,000 µg/m^3. The standard, taken from the 2008 CAFÉ Directive 2000/69/EC, came into force in 2011.

Long term CO monitoring was carried out at one Zone D locations in 2016 (Not conducted in Zone D locations in 2017). The 8-hour CO concentrations was 4mg/m^3 in 2016 which is below the 8-hour limit value (on a rolling basis) of 10 mg/m^3.

Particulate Matter PM_{10}

The Air Quality Standards Regulations 2011 specify a PM_{10} limit value of 40 µg/m^3 over a calendar year. The standard, taken from the 2008 CAFÉ Directive 2000/69/EC, came into force in 2011.

Long term PM_{10} monitoring was carried out at three Zone D locations in 2017. The PM_{10} average in 2017 for these sites ranged from 7.8 – 11.2 µg/m^3. Therefore, long term averages were below the annual average limit of 40 µg/m^3.

Particulate Matter $PM_{2.5}$

The Air Quality Standards Regulations 2011 specify a $PM_{2.5}$ limit value of 25 µg/m^3 over a calendar year.

Long term $PM_{2.5}$ monitoring was carried out at two Zone D locations in 2017. The $PM_{2.5}$ average in 2017 for these sites ranged from 5.6 – 9.2 µg/m^3. Therefore, long term averages were below the target value 25 µg/m^3.

Benzene

The Air Quality Standards Regulations 2011 specify a benzene limit value of 5 µg/m^3 over a calendar year. The standard, taken from the 2008 CAFÉ Directive 2000/69/EC, came into force in 2011.

Long term benzene monitoring was carried out at Zone A & C locations only in 2017 and not at any Zone D locations. The benzene average in 2017 for Zone C was <0.18 µg/m^3. Therefore, long term averages were below the limit value 5 µg/m^3. It would therefor be expected that Zone D locations would be lower than the reported Zone C levels.

Table 9.5 below presents a summary of the 2017 Air Quality data obtained from the Zone D locations which may be considered to be broadly representative to that of the subject site.

Table 9.5 Summary of the 2017 Air Quality data obtained from Zone D areas

Pollutant	Regulation	Limit type	Limit value	EPA monitoring data 2017
Nitrogen dioxide	2008/50/EC	Annual limit for protection of human health	40 µg/m^3	2 - 7 µg/m^3
Sulphur dioxide	2008/50/EC	Daily limit for protection of human health (not to be exceeded more than 3 times per year)	125 µg/m^3	3 - 4 µg/m^3
Carbon monoxide	2008/50/EC	8-hour limit (on a rolling basis) for protection of human health (Zone C)	10,000 µg/m^3	1.500 µg/m^3
Particulate matter (as PM_{10})	2008/50/EC	Annual limit for protection of human health	40 µg/m^3	8 - 11 µg/m^3
Particulate matter (as $PM_{2.5}$)	2008/50/EC	Annual limit for protection of human health	25 µg/m^3	6 - 9 µg/m^3
Benzene	2008/50/EC	Annual limit for protection of human health	5 µg/m^3	< 0.20 µg/m^3 (Zone C)

9.3.4 Baseline air quality monitoring

A site specific short-term monitoring study was conducted for Nitrogen oxides, Sulphur dioxide and BTEX (Benzene, Toluene, Ethylbenzene and Xylene). All pollutants were measured at two locations (AQM1, AQM2) using passive diffusion tubes over a two week period. Figures 9.2 & 9.3 identifies the monitoring locations. The baseline survey was conducted between 21st February to 5th March 2018 when the potential for higher ambient levels of fossil fuel generated pollutants would be present.

These locations were chosen in order to obtain short-term sample concentrations for the identified parameters from the principal sources of pollution i.e. vehicle exhaust emissions and home heating fossil fuel emissions.

The survey was indicative only and results obtained cannot be used to demonstrate compliance with short-term or annual limit values detailed in Table 9.1 above. The survey does, however, aid in identifying the influence of sources in the vicinity of the proposed development site. The results from the monitoring surveys are presented in Table 9.6.

The concentrations of NO_2, SO_2 ,BTEX and dust deposition levels measured during the short term measurement survey were significantly below their respective annual limit values and comparable with levels reported by the EPA.

Table 9.6 Results of passive diffusion tube monitoring at Dunshaughlin development site

Pollutant	Sampling period	Concentration A1 Southern Site Boundary	Concentration A2 Northern site boundary	Assessment criteria
Nitrogen dioxide	21.02.18 – 05.03.18	<2.3 µg/m^3	<2.3 µg/m^3	40 µg/m^3 (as annual average)
Sulphur dioxide	21.02.18 – 05.03.18	8.4 µg/m^3	<1.5 µg/m^3	125 µg/m^3 (as annual average)
Benzene	21.02.18 – 05.03.18	<2 µg/m^3	<2 µg/m^3	10 mg/m^3 (as annual average)
Ethylbenzene	21.02.18 – 05.03.18	<1 µg/m^3	<1 µg/m^3	N/A
Toulene	21.02.18 – 05.03.18	<4.9 µg/m^3	<4.9 µg/m^3	N/A
m/p-Xylene	21.02.18 – 05.03.18	<1 µg/m^3	<1 µg/m^3	N/A
o-Xylene	21.02.18 – 05.03.18	<1 µg/m^3	<1 µg/m^3	N/A
Dust	05.02.18 – 05.03.18	<49 mg/m^2-day	<49mg/m^2-day	350 mg/m^2-day

Note 1: Annual limit
Note 2 < value indicates below Laboratory limit of detection

9.3.5 Significance

Based on published EPA air quality data for the Zone D area in which the subject site is located together with site specific monitoring data, it may be concluded that the existing baseline air quality at the subject site may be characterised as being good with no exceedances of the National Air Quality Standards Regulations 2011 (S.I No. 180 of 2011) limit values of individual pollutants. The quality of existing air quality at the subject site must be maintained and improved where possible as a result of the proposed development to ensure that local human health and the ecological environment is not adversely affected.

9.3.6 Sensitivity

The subject site shall be developed by ground clearance and site preparation works and the subsequent construction of residential units, retail units, a creche, a community centre, a primary care/gymnasium unit, roads, open spaces and landscaped areas. The principal local receptors that may be impacted by the development are existing residential developments to the south (The Willows), west (Maeldun) and north (Coldricks Pass) of the site.

Figure 9.2 Baseline Air Quality Locations A1 &A2 existing site

Figure 9.3 Baseline Air Quality Locations A1 &A2 showing development

9.4 CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

When considering a development of this nature, the potential impact on air quality and climate must be considered for each distinct stage: the short (1-5 years) and medium term (6-9 years) impact of the construction phase and the longer term impact of the operational phase. The construction phase will be undertaken over a 7 to 10 year period under a 10-year permission period. It is important that there are no unacceptable decreases in ambient air quality levels predicted during the construction phases and during the operational phase. Details of the indicative phased delivery of the proposed development set out in Chapter 2 of the EIAR.

9.5 POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT

The construction phase of the development has the potential to generate short term fugitive dust emissions during ground preparation and enabling works and from general site construction activities, however, these emissions will be controlled by appropriate mitigation techniques and through the implementation of a construction phase air quality management and monitoring plan throughout the duration of the construction phase to ensure that existing adjacent residential properties, lands utilised by local sports clubs and business premises in the Dunshaughlin Business Park will not be adversely impacted by a deterioration in air quality associated with the construction phase.

The operational phase of the development will see the operation of modern, well insulated thermally efficient buildings in which energy efficiency shall be achieved by implementing sustainable features into the building design.

National air quality standards shall not be adversely affected as a result of the short-term construction phase or the operational phase, thus ensuring that the potential for adverse impacts on human health is negligible.

The proposed development does not include the construction of any high structures (maximum 5 storey heights in the neighbourhood centre) which may impact on the local micro climate by means of shadowing effects or wind sheer effects, therefore the proposed development will not to have an adverse impact on shading or temperature profiles at the nearest existing residential properties or on the local receiving environment in the vicinity of the site boundaries.

Road traffic and residential heating are the typical sources of greenhouse gas emissions associated with a residential or mixed use development. EPA guidance states that a development may have an influence on global climate where it represents “a significant proportion of the national contribution to greenhouse gases”.

9.5.1 Potential Impacts – Construction & Operational Phases

Various elements of both the construction and operational phases of the proposed development have the potential to impact on the local receiving environment, on adjacent residential properties and on human health. The likely potential impacts for both construction and operation of the proposed scheme prior to mitigation are described in this section of the EIAR. The mitigation measures are described in Section 9.8 and the predicted impacts in Section 9.9.

Construction Phase Impacts

Air quality

The development of the site will be conducted in the following phased stages:

- Enabling works - Site set up and Site clearance
- Construction works including site infrastructure, houses, apartments commercial buildings and

landscaping

Construction impacts with both of these phased stages are considered below.

Enabling works - Site Set Up and Clearance

Works activities associated with the 'Site set up' will be undertaken prior to construction works commencing in each sub-phase. The setting up of the site shall involve the construction of site security hoarding and site compounds, site offices, materials and waste storage areas and staff welfare facilities. These temporary activities will have a minimal potential to generate fugitive dust emissions or combustion gas emissions.

Site clearance and ground excavation works will be undertaken in separate phases and these activities have the potential to generate fugitive windblown dust emissions rising from the operation of mechanical plant such as dozers, excavators and tipper trucks and the movement of these vehicles on exposed surfaces at the site. With regard to the phased development approach, only one phase at a time shall be developed with the remaining phased areas remaining generally undisturbed until such a time as they are developed. Infrastructural works will be required to facilitate site services but it is not predicted that there would be bulk excavations of stripped soils until such a time as the development of subsequent phases are commenced.

With regard to the volume of waste material (top and sub soils) generated during site clearance (c. 55,000m^3 of which c. 32,000m^3 shall be retained for landscaping and c. 23,000m^3 shall be exported off-site), there will be a requirement for HGV trucks to remove the material from the site. Top soils shall be stockpiled and covered on site for re-use during final landscaping works. Trucks shall be loaded with material on-site by mechanical excavators and loading shovels which will generate fugitive dust emissions as a result of the transfer of the excavated materials comprised principally of soils and stones from stockpile to truck.

The movements of construction vehicles on the site shall also generate windblown dust emissions. Where dusty waste material is loaded onto exposed open trucks, fine dusts may be released as the truck travels along public roads.

It is estimated that there will be a maximum of 4 (No.) x 20 tonne tipper truck movements per hour or an average of 32 movements per day associated with site clearance works for each phase of development. This relatively small volume of truck movements will have a negligible impact on local ambient air quality. In general, site clearance works would occur for an approximate 2 - 3 month period.

The impact on local air quality during Site Set Up and Clearance will be temporary in nature and will result in a potentially minor impact on local air quality and sensitive receptors provided that all mitigation measures are implemented.

Stockpiled topsoils shall be covered to prevent their erosion and shall eventually be re-used in landscaping works on the site.

Building and Site Infrastructure Construction Works

During the construction phase there will be extensive site works, involving construction machinery, construction activities on site which have the potential to generate fugitive windblown dust emissions.

Construction equipment including generators and compressors will also give rise to some exhaust emissions. However, due to the size and nature of construction activities, exhaust emissions during construction will have a negligible impact on local air quality.

Construction traffic to and from the site shall result in a short term increase in the volume of diesel fuelled HGV's along the local road network which will generate additional hydrocarbon and particulate emissions from the vehicle exhausts.

The construction phase activities will result in a minor impact on local air quality as a result of the implementation of the mitigation measures detailed below in Section 9.8,

Climate

During the construction phase, existing vegetated areas throughout the development site will be removed due to site clearance works and associated movement of construction traffic thus impacting the micro-climate. Whilst this will impact the evapotranspiration rates of vegetation, there will be no impact upon the moisture evaporation from the exposed soil. Therefore, there will be no significant impacts on microclimate.

CO_2 will be released into the atmosphere as a result of the movement of construction vehicles and use of plant. However emissions associated with such activities will occur over a short-term period (c. 10 years) which will not result in an adverse impact on the local micro or the broader macro climate.

Operational Phase Impacts

Air quality

The operational phase of the proposed development will result in a slight impact on local air quality primarily as a result of the requirements of new buildings to be heated and with the increased traffic movements associated with the development.

Traffic movements associated with the development have been evaluated and assessed as part of the Traffic Impact Assessment by ILTP Consulting for the development which includes parking for vehicles which will enter and exit the site via the R147. The split in am and pm peak traffic movements will not result in an adverse impact on local air quality at any of the junctions and it is predicted that the impact of car engine exhaust emissions will have a negligible impact on local ambient air quality. It is expected that a proportion of the commuting residents will avail of the Bus Eireann and private bus operators commuter services and the local Iarnrod Eireann rail service at Pace in Dunboyne. The availability of public transport will significantly reduce the number of private vehicles exiting and entering the development during am and pm peak times.

The design and construction of all buildings in accordance with National Building Regulations *(The Irish Building Regulations Technical Guidance Document L – Conservation of Fuel & Energy – Dwellings)* shall ensure that modern building materials are used and that they are designed to be thermally efficient resulting in a reduction in the volume of fossil fuels required to heat the buildings. It is predicted that fossil fuel combustion gas emissions including Carbon Dioxide, Sulphur Dioxide, Nitrogen Oxides, Carbon Monoxide and hydrocarbon particulate emissions will be slight and will not have an adverse significant impact on the existing ambient air quality in the vicinity of the proposed development site.

In order to counteract the potential impact of the development on the existing and future climate, the design of the proposed residential apartments and houses shall consider a number of sustainable heating and energy saving features.

Climate

The site area of the development lands is c. 28.3 hectares which will include open space and landscaped areas. The overall development includes the construction of buildings and roadways which will have the effect of marginally raising localised air temperatures, especially in summer. It is predicted that the proposed development

will not have an adverse impact on the local micro-climate or on the local receiving environment in the vicinity of the development site.

The development of open areas on the site will continue to contribute albeit in a minor way to the adsorption of Carbon Dioxide from the atmosphere and the release of Oxygen to the atmosphere.

The proposed development includes apartment structures which will have a minor impact on the local micro-climate by means of wind sheer effects. There will however be no unacceptable impact within or beyond the overall site.

Greenhouse gases occur naturally in the atmosphere (e.g. carbon dioxide, water vapour, methane, nitrous oxide and ozone) and in the correct balance, are responsible for keeping the lower part of the atmosphere warmer than it would otherwise be. These gases permit incoming solar radiation to pass through the Earth's atmosphere, but prevent most of the outgoing infrared radiation from escaping from the surface and lower atmosphere into the upper levels. However, human activities are now contributing to an upward trend in the levels of these gases, along with other pollutants with the net result of an increase in temperature near the surface.

Motor vehicles are a major source of atmospheric emissions which contribute to climate change, however, vehicle exhaust emissions generated from vehicles associated with the development will have a negligible impact on the macro-climate given modern technological developments in cleaner and more efficient vehicle engines.

To further reduce the climatic impact of the operational phase of the development, electric vehicle charging points shall be installed in dedicated parking spaces at each apartment block to facilitate residents who own electric vehicles and to encourage other residents to purchase electric vehicles.

The scheme has been designed to provide thermally efficient buildings which will reduce the consumption of fossil fuels within each individual dwelling. This will reduce the impact the operational phase of the development will have on the micro and macro climate. In particular, there will be no "traditional" passive air vents in the apartments which are both thermally and acoustically inefficient. Mechanical Ventilation and Heat Recovery (MVHR) systems shall be incorporated into the design of the apartments. The MVHR systems together with thermally and acoustically rated window sets will reduce the potential future impacts that the external climate will have in terms of wind and changing temperatures on the internal environment within the residential units. These design features will ensure the units are thermally efficient thus reducing the use of fossil fuels leading to a reduction of the impact on climate.

The thermal efficiency of the buildings will ensure that the development will be sustainable and will be protected against the impacts of future climate change which may include storm events and prolonged colder periods during the winter season.

9.6 CUMULATIVE IMPACTS

In accordance with *The Planning and Development Regulations 2001 as amended*, this section has considered the cumulative impact of the proposed development in conjunction with future and current development in the vicinity of the subject site. This section relates to the cumulative impact on the subject site itself and on surrounding sites.

The European Commissions report of May 1999 'Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions' defines cumulative impact as follows:

"Impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project".

The cumulative air quality impact of the existing residential development, under construction residential development and existing local transport infrastructure together with the proposed development is assessed with regard to having established the baseline air quality and then predicting the impact that the proposed development will have on the baseline air quality. Together the combined impact can be assessed to determine if there is sufficient "atmospheric budget" to facilitate the proposed development.

It is predicted that the cumulative impact of the construction and operational phases of the subject development and the currently under construction development (The Willows) will not have an adverse long term impact on the receiving environment.

It is considered that there will be the potential for a short term slight negative cumulative impact associated with the construction phase of the subject development on ambient air quality and climate primarily as a result of the use of diesel to fuel construction plant and equipment. However, through the implementation of the Construction Phase air quality mitigation measures and the integration into the design of the operational development of sustainable aspects and energy reduction features will ensure the receiving environment including off site residential receptors and existing habitats will not be adversely impacted.

9.7 DO NOTHING IMPACT

The subject site is currently comprised of agricultural lands and if they remain undeveloped the site will continue to have no adverse impact on existing ambient air quality or on the local micro-climate.

Based on the projected increase in traffic up to the reference year of 2035, the increase in traffic related emissions, based on projected Traffic Impact Assessment figures without the subject development would be insignificant. This increase above the existing situation would be minor and would not result in a perceptible change in the existing local air quality environment.

9.8 AVOIDANCE, REMEDIAL AND MITIGATION MEASURES

This section provides the measures that shall be implemented during the construction and operational phase and into the design of the development to miminise the impacts on the receiving environment, local population and human health, livestock and agricultural lands, local flora and fauna, local businesses and on climate.

9.8.1 Construction Phase

In order to ensure that adverse air quality impacts are minimised during the construction phase and that the potential for soiling of property and amenity and local public roads is minimised, the following mitigation measures shall be implemented during the course of all construction activities:

AQ CONST 1: Air Quality Mitigation Measures

- Avoid unnecessary vehicle movements and manoeuvring, and limit speeds on site so as to minimise the generation of airborne dust.
- Use of rubble chutes and receptor skips during construction activities.
- During dry periods, dust emissions from heavily trafficked locations (on and off site) will be controlled by spraying surfaces with water and wetting agents.
- Hard surface roads will be swept to remove mud and aggregate materials from their surface while any un-surfaced roads will be restricted to essential site traffic only.
- Re-suspension in the air of spillages material from trucks entering or leaving the site will be prevented by limiting the speed of vehicles within the site to 10kmh and by use of a mechanical road sweeper.
- The overloading of tipper trucks exiting the site shall not be permitted.
- Aggregates will be transported to and from the site in covered trucks.

- Where the likelihood of windblown fugitive dust emissions is high and during dry weather conditions, dusty site surfaces will be sprayed by a mobile tanker bowser.
- Wetting agents shall be utilised to provide a more effective surface wetting procedure.
- Exhaust emissions from vehicles operating within the construction site, including trucks, excavators, diesel generators or other plant equipment, will be controlled by the contractor by ensuring that emissions from vehicles are minimised by routine servicing of vehicles and plant, rather than just following breakdowns; the positioning of exhausts at a height to ensure adequate local dispersal of emissions, the avoidance of engines running unnecessarily and the use of low emission fuels.
- All plant not in operation shall be turned off and idling engines shall not be permitted for excessive periods.
- Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind. Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods.
- Material stockpiles containing fine or dusty elements including top soils shall be covered with tarpaulins.
- Where drilling or pavement cutting, grinding or similar types of stone finishing operations are taking place, measures to control dust emissions will be used to prevent unnecessary dust emissions by the erection of wind breaks or barriers. All concrete cutting equipment shall be fitted with a water dampening system.
- A programme of air quality monitoring shall be implemented at the site boundaries for the duration of construction phase activities to ensure that the air quality standards relating to dust deposition and PM_{10} are not exceeded. Where levels exceed specified air quality limit values, dust generating activities shall immediately cease and alternative working methods shall be implemented.
- A complaints log shall be maintained by the construction site manager and in the event of a complaint relating to dust nuisance, an investigation shall be initiated.
- Dust netting and site hoarding shall be installed along the southern, western and north-western site boundaries to minimise fugitive windblown dust emissions falling on existing residential areas and the Dunshaughlin Business Park.

9.8.2 Operational Phase

The Operational Phase of the Dunshaughlin development site will not generate air emissions that would have an adverse impact on local ambient air quality or local human health. The following mitigation measures relating to the design and operational phase of the development will reduce the impact on air quality and climate:

AQ OP1 : Climate Impact Mitigation Measures
Energy Efficiency - All proposals for development shall seek to meet the highest standards of sustainable design and construction with regard to the optimum use of sustainable building design criteria such as passive solar principles and also green building materials.

All residential units shall be designed and constructed in accordance with The Irish Building Regulations *Technical Guidance Document L – Conservation of Fuel & Energy – Dwellings* amended in 2017 includes requirements for all residential dwellings to be "Nearly Zero Energy Buildings" (NZEB's) by 31st December 2020, where applicable.

In order to reduce energy consumption, the following key design features have been considered in the design process and will be incorporated into the construction of the residential units:

- Passive solar design including the orientation, location and sizing of windows
- The use of green building materials: low embodied energy & recycled materials
- Energy efficient window units and frames with certified thermal and acoustic insulation properties
- Building envelope air tightness
- Installation of Mechanical Ventilation & Heat Recovery systems in all apartment units which operate by extracting warm air from kitchens and bathrooms, cleaning it and distributing it to other rooms in the unit.
- Thermal insulation of walls and roof voids of all units

AQ OP2: Air Quality Mitigation Measures

- Natural Gas heating in all units
- Inclusion of electric car charging points to encourage electric vehicle ownership
- Mobility management measures which support use of sustainable transport modes, supported by the developments proximity of Bus Eireann and private bus operator's commuter services on the R147 Dublin Road and proximity of Iarnrod Eireann's park and ride facility at Pace, Clonee train station
- Provision of open landscaped areas, pedestrian and cycle routes to encourage residents to avail of healthy lifestyle options

9.9 PREDICTED IMPACTS OF THE PROPOSED DEVELOPMENT

Various elements associated with the construction phase of the proposed development have the potential to impact local ambient air quality, human health and climate, however the potential construction phase impacts shall be mitigated as detailed in Section 9.8 above to ensure there is no adverse impact on ambient air quality for the duration of all construction phase works. It is predicted that the operational phase of the development will not generate air emissions that would have an adverse impact on local ambient air quality or local human health or local livestock welfare.

The sustainable features that are incorporated into the design of all residential units will ensure that the operational phase of the development at Dunshaughlin will not have an adverse impact on local air quality or on local or global climate patterns. The residential units will be designed to ensure that they can withstand the potential changes in climate which may generate more extreme and prolonged meteorological events in the future.

9.10 MONITORING

This section describes the dust monitoring methodologies that shall be implemented at the site during the construction phases to ensure that dust and construction vehicle exhaust emissions as NO_2 generated by site activities does not cause nuisance or cause adverse health effects to residential areas and other receptors located in the vicinity of the site boundaries.

Dust Deposition Monitoring Methodology

Dust deposition levels will be monitored to assess the impact that site construction site activities may have on the local ambient air quality and to demonstrate that the environmental control measures in place at the site are effective in minimising the impact of construction site activities on the local receiving environment including existing residential developments and the Dunshaughlin Business Park bordering the site. The following procedure shall be implemented at the site on commencement of site activities:

The dust deposition rate will be measured by positioning Bergerhoff Dust Deposit Gauges at strategic locations near the boundaries of the site for a period of 30 +-2 days. Monitoring shall be conducted on a monthly basis during periods when the highest levels of dust are expected to be generated i.e., during site preparation works and soil stripping activities and on a quarterly basis thereafter. The proposed monitoring locations (D1 – D4) are presented below in Figure 9.4.

The selection of sampling point locations will be completed after consideration of the requirements of *Method VDI 2119* with respect to the location of the samplers relative to obstructions, height above ground and sample collection and analysis procedures. The optimum locations will be determined by a suitably qualified air quality expert to ensure that the dust gauge locations are positioned in order to best determine potential dust deposition in the vicinity of the site boundaries and existing on-site buildings.

After each (30 +-2 days) exposure period, the gauges will be removed from the sampling location, sealed and the dust deposits in each gauge will be determined gravimetrically by an accredited laboratory and expressed as a dust deposition rate in mg/m^2-day in accordance with the relevant standards.

Technical monitoring reports detailing all measurement results, methodologies and assessment of results shall be subsequently prepared and maintained by the Site Manager. Monitoring reports shall be made available to the Local Authority as requested.

A dust deposition limit value of 350 mg/m^2-day (measured as per German Standard Method VDI 2119 – *Measurement of Particulate Precipitations – Determination of Dust Precipitation with Collecting Pots Made of Glass (Bergerhoff Method) or Plastic*. is commonly specified by Local Authorities and by the EPA to ensure that no nuisance effects will result from specified activities and it is to this Best Practice standard method that this programme of dust monitoring and control has been prepared.

The *German Federal Government Technical Instructions on Air Quality Control - TA Luft* specifies an emission value for the protection against significant nuisances or significant disadvantages due to dustfall. This limit value is 350 mg/m^2-day and it is to this limit value that all measured dust deposition levels shall be assessed. This limit value is commonly specified by Local Authorities at construction sites.

The results of all dust deposition surveys shall be maintained by the Project Manager and shall be made available to Meath County Council.

NO_2 Monitoring Methodology

In order to assess the impact on existing air quality that vehicle and plant exhaust emissions associated with the construction phase of the development may have, it is proposed that a programme of Nitrogen Dioxide monitoring shall be undertaken for a 1 year period at the baseline air quality locations, A1 & A2. The purpose of this monitoring programme will be to verify the effectiveness of the various construction phase mitigation measures and to quantify by measurement, the concentration of NO2 in the ambient air to allow for the assessment of measured NO_2 levels against levels measured in EPA Zone D areas over a similar period. NO2 levels shall also be assessed against the annual limit value NO_2 as defined in National Air Quality Standards Regulations 2011 (S.I No. 180 of 2011) which specify an annual limit value of 40 µg/m^3, for the protection of human health, over a calendar year.

Figure 9.4 Construction Phase dust deposition monitoring locations D1 – D4 & NO_2 monitoring locations A1 – A2

9.11 REINSTATEMENT

Reinstatement issues are not relevant to this Chapter of the EIAR.

9.12 INTERACTIONS

The traffic data used in the assessment of air quality impact was obtained from the traffic consultant, ILTP Consulting, for the proposed development.

The principal interactions between Air & Climate impacts and Population and Human Health have been addressed in Section 9.8 of this report which describes in detail the mitigation measures that shall be implemented to ensure that human health, residential amenity and livestock welfare are not adversely impacted by any aspect of the construction or operational phases of the development.

Similarly, the mitigation measures have also been designed to minimise the potential impact that the construction and operational phases of the development may have on the receiving environment which includes biodiversity.

The concept of control and attenuation at source of potential emission sources that may impact the receiving environment is the principal that has been adapted in the design, construction and operational phases of the development, in this respect the author has liaised with the project architects, engineers and landscape architects to inform the detailed design process.

9.13 DIFFICULTIES ENCOUNTERED IN COMPILING INFORMATION

There were no difficulties encountered in compiling this Chapter of the EIAR.

9.14 REFERENCES & SOURCES

Air Quality Regulations 2011, SI 180 of 2011
European Union (Planning & Development)(Environmental Impact Assessment) Regulations 2018 (SI No. 296 of 2018).
Environmental Impact Assessment of Projects – Guidance on the preparation of the EIAR, European Commission, 2017.
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German Standard Method for determination of dust deposition rate, *VDI 2129.*
Greater London Authority – The Control of dust emissions from construction and demolition – Best Practice Guidelines, Nov 2006.
Transport Infrastructure Ireland (TII) 2011 Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes Revision 1.
The Irish Building Regulations *Technical Guidance Document L – Conservation of Fuel & Energy – Dwellings*