Table of Contents

List of Figures and Tables

List of Appendices

8 Air Quality and Climatic Factors

8.1 Introduction

This chapter assesses the likely air quality and climate impacts, if any, associated with the proposed Glenamuck District Roads Scheme. A full description of the development can be found in Chapter 5.

This chapter was completed by Ciara Nolan, an Environmental Consultant at AWN Consulting. She holds an MSc. (First Class) in Environmental Science from University College Dublin and has also completed a BSc. in Energy Systems Engineering. She is an Associate Member of both the Institute of Air Quality Management and the Institution of Environmental Science. She has been active in the field of air quality for 2 years, with a primary focus on consultancy.

8.1.1 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 1).

Air quality significance criteria are assessed on the basis of compliance with the appropriate standards or limit values. The applicable standards in Ireland include the Air Quality Standards Regulations 2011, which incorporate EU Directive 2008/50/EC, which has set limit values for NO_2, PM_{10}, $PM_{2.5}$, benzene and CO (see Table 8- 1: Air Quality Standards Regulations). Although the EU Air Quality Limit Values are the basis of legislation, other thresholds outlined by the EU Directives are used which are triggers for particular actions (see Appendix 8-1).

Table 8- 1: Air Quality Standards Regulations

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

Note 1 EU 2008/50/EC – Clean Air For Europe (CAFÉ) Directive replaces the previous Air Framework Directive (1996/30/EC) and daughter directives 1999/30/EC and 2000/69/EC

8.1.2 Climate Agreements

Ireland ratified the United Nations Framework Convention on Climate Change (UNFCCC) in April 1994 and the Kyoto Protocol in principle in 1997 and formally in May 2002 (UNFCCC, 1997; 1999). For the purposes of the EU burden sharing agreement under Article 4 of the Kyoto Protocol, in June 1998, Ireland agreed to limit the net growth of the six GHGs under the Kyoto Protocol to 13% above the 1990 level over the period 2008 to 2012 (ERM, 1998; European Commission, 2014). 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 (COP23) took place in Bonn, Germany from the 6th to the 17th of November 2017 and focused on advancing the implementation of the Paris Agreement. 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" (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.

8.1.3 Gothenburg Protocol

In 1999, Ireland signed the Gothenburg Protocol to the 1979 UN Convention on Long Range Transboundary Air Pollution. The initial objective of the Protocol was to control and reduce emissions of Sulphur Dioxide (SO_2), Nitrogen Oxides (NO_X), Volatile Organic Compounds (VOCs) and Ammonia (NH_3). To achieve the initial targets Ireland was obliged, by 2010, to meet national emission ceilings of 42 kt for SO_2 (67% below 2001 levels), 65 kt for NO_X (52% reduction), 55 kt for VOCs (37% reduction) and 116 kt for NH_3 (6% reduction). In 2012, the Gothenburg Protocol was revised to include national emission reduction commitments for the main air pollutants to be achieved in 2020 and beyond and to include emission reduction commitments for $PM_{2.5}$. 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 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, 2004; 2007). 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 (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 SO_2, NO_X, NMVOC, NH_3, $PM_{2.5}$ and CH_4. In relation to Ireland, 2020 - 2029 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).

8.2 Methodology

8.2.1 Local Air Quality

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

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

- The baseline scenario (2017), for model verification;
- Opening Year Do-Nothing scenario (DN), which assumes the retention of present site usage with no development in place (2020);
- Opening Year Do-Something scenario (DS), which assumes the proposed scheme in place (2020);
- Design Year Do-Nothing scenario (DN), which assumes the retention of present site usage with no development in place (2035); and
- Design Year of the Do-Something scenario (DS), which assumes the proposed scheme in place (2035).

The assessment methodology involved air dispersion modelling using the UK DMRB Screening Model (Version 1.03c, July 2007), the NO_x to NO_2 Conversion Spreadsheet (Version 5.1, June 2016) (UK DEFRA, 2016), and following guidance issued by the TII (2011), UK Highways Agency (2007), UK DEFRA (2016a; 2016b), UK DETR (1998) and the EPA (2002; 2003; 2015; 2017a).

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

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

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

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

Concentrations of key pollutants are calculated at sensitive receptors that have the potential to be affected by the proposed scheme. For road links which are deemed to be affected by the proposed scheme and within 200 m of the chosen sensitive receptors inputs to the air dispersion model consist of road layouts, receptor locations, annual average daily traffic movements (AADT), percentage heavy goods vehicles, annual average traffic speeds and background concentrations.

The UK DMRB guidance states that road links at a distance of greater than 200 m from a sensitive receptor will not influence pollutant concentrations at the receptor. Using this input data the model predicts the road traffic contribution to ambient ground level concentrations at the worst-case sensitive receptors using generic meteorological data. The DMRB model uses conservative emission factors, the formulae for which are outlined in the DMRB Volume 11 Section 3 Part 1 – HA 207/07 Annexes B3 and B4. These worst-case road contributions are then added to the existing background concentrations to give the worst-case predicted ambient concentrations. The worst-case ambient concentrations are then compared with the relevant ambient air quality standards to assess the compliance of the proposed scheme with these ambient air quality standards. The TII *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (2011) detail a methodology for determining air quality impact significance criteria for road schemes. The degree of impact is determined based on both the absolute and relative impact of the proposed development. The TII significance criteria have been adopted for the proposed development and are detailed in Appendix 8.2, Table A.8.2.1 to Table A.8.2.3. The significance criteria are based on PM_{10} and NO_2 as these pollutants are most likely to exceed the annual mean limit values (40 μg/m^3). However, the criteria have also been applied to the predicted 8-hour CO, annual benzene and annual $PM_{2.5}$ concentrations for the purposes of this assessment.

8.2.2 Regional Air Quality & Climate Assessment

The impact of the proposed scheme on climate at a national / international level is determined using the procedures given by Transport Infrastructure Ireland (2011) and the methodology provided in Annex 2 of the UK Design Manual for Roads and Bridges (UK Highways Agency, 2007). The assessment focuses 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.

8.2.3 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 NOx emitted as NO_2, rather than NO is increasing. With the correct conditions (presence of sunlight and O_3) emissions in the form of NO, have the potential to be converted to NO_2.

Transport Infrastructure Ireland states the recommended method for the conversion of NO_x to NO_2 in "*Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes*" (2011). The TII guidelines recommend the use of DEFRAs NO_x to NO_2 calculator (2017) 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 the TII guidance recommends the use of 'Armagh, Banbridge and Craigavon' as the choice for local authority when using the calculator. The choice of Craigavon provides the most suitable relationship between NO_2 and NO_x for Ireland. The "All other Non-Urban UK Traffic" traffic mix option was used.

8.3 Baseline Environment

8.3.1 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). 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 Dublin Airport, which is located approximately 23 km north of the proposed scheme at its furthest point. Dublin Airport met data has been examined to identify the prevailing wind direction and average wind speeds over a five-year period (see Figure 8- 1: **Dublin Airport Windrose 2012 – 2016**). For data collated during five representative years (2012 - 2016), the predominant wind direction is westerly to south-westerly, with generally moderate wind speeds.

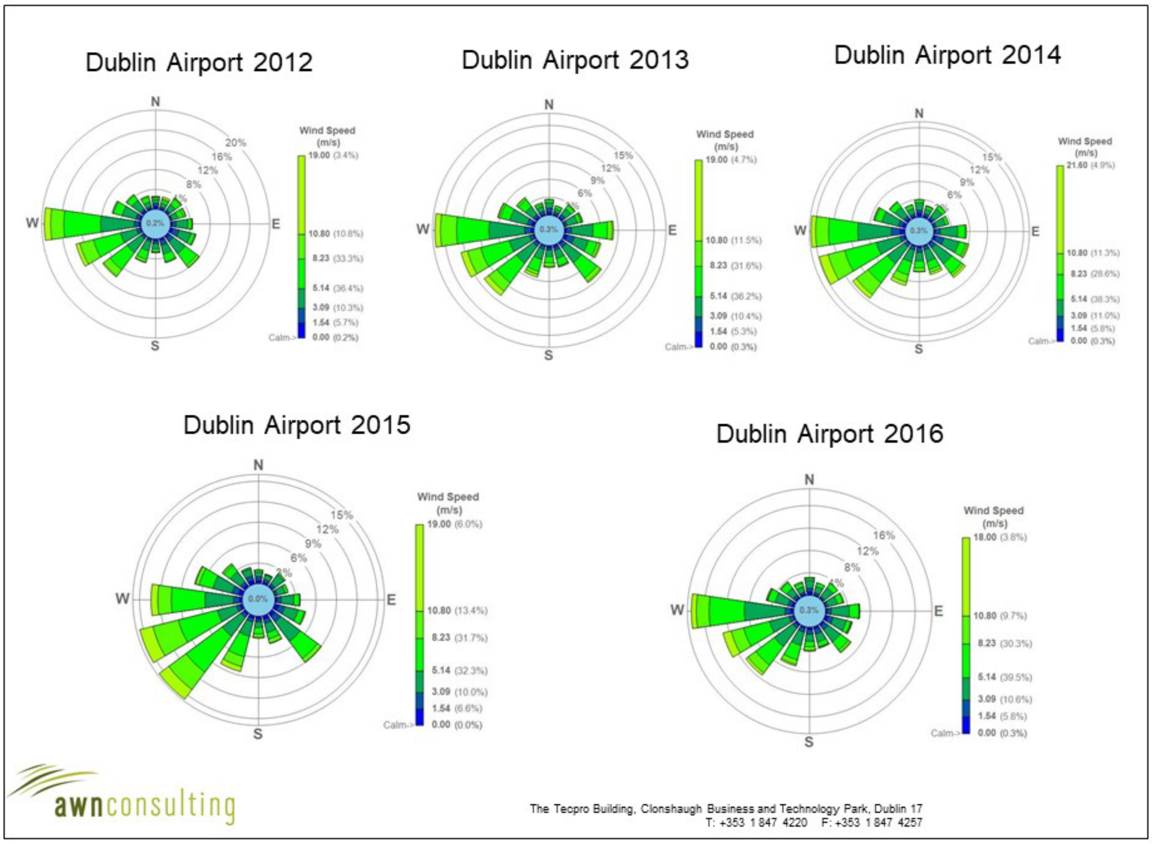

Figure 8- 1: Dublin Airport Windrose 2012 – 2016

8.3.2 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 (WHO, 2006).. Thus, residential exposure is determined by the location of sensitive receptors relative to major roads sources in the area. Temporally, air quality can vary significantly by orders of magnitude due to changes in traffic volumes, meteorological conditions and wind direction. In 2011 the UK DEFRA published research (2011) 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 DEFRA previously published and monitored concentrations. The impact of this 'gap' is that the DMRB screening model can under-predict NO_2 concentrations for predicted for future years. Subsequently, the UK Highways Agency (HA) published an Interim advice note (IAN 170/12) in order to correct the DMRB results for future years.

8.3.3 Review of Available Background Air Quality Data

Air quality monitoring programs have been undertaken in recent years by the EPA and Local Authorities. The most recent annual report on air quality in Ireland is "*Air Quality In Ireland 2016 – Indicators of Air Quality*" (EPA, 2017a). The EPA website details the range and scope of monitoring undertaken throughout Ireland and provides both monitoring data and the results of previous air quality assessments (EPA, 2018).

As part of the implementation of the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002), four air quality zones have been defined in Ireland for air quality management and assessment purposes (EPA, 2018). Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 23 towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000, is defined as Zone D. In terms of air monitoring and assessment, the proposed scheme is within Zone A (EPA, 2017b). The long-term monitoring data has been used to determine background concentrations for the key pollutants in the region of the proposed scheme. The background concentration account for all non-traffic derived emissions (e.g. natural sources, industry, home heating etc.).

With regard to NO_2, continuous monitoring data from the EPA (EPA, 2017a, 2018) at the Zone A locations of Winetavern Street, Rathmines, Dún Laoghaire and Swords show that levels of NO_2 are below both the annual and 1-hour limit values. Average long-term concentrations range from 13 - 37 $\mu g/m^3$ for the period 2012 – 2016; city centre roadside locations experience higher concentrations and are not representative of the area of the proposed scheme (see Table 8- 2: Trends In Zone A Air Quality - Nitrogen Dioxide (NO_2)). There were four exceedances of the maximum 1 hour limit of 200 $\mu g/m^3$ in Swords in 2014 (18 exceedances are allowed per year). The most representative monitoring station is Dún Laoghaire which is located approximately 5km north-east of the proposed scheme and suggests an upper average annual mean concentration of no more than 17 $\mu g/m^3$. Based on these results a conservative estimate of the current background NO_2 concentration in the region of proposed scheme is 19 $\mu g/m^3$.

Table 8- 2: Trends In Zone A Air Quality - Nitrogen Dioxide (NO_2)

Year	Winetavern Street	Rathmines	Dún Laoghaire	Swords
2012	29	21	18	15
2013	31	19	16	15
2014	31	17	15	14
2015	31	18	16	13
2016	37	20	19	16
Average	**31.7**	**19.0**	**16.7**	**14.5**

Continuous PM_{10} monitoring carried out at the locations of Winetavern Street, Rathmines, Dún Laoghaire and Tallaght showed annual mean concentrations for the 2012 – 2016 period ranging from 12 – 17 µg/m^3 (Table 8- 3: Trends In Trends In Zone A Air Quality - PM_{10}), with at most 8 exceedances (in Rathmines) of the 24-hour limit value of 50 µg/m^3 (35 exceedances are permitted per year) (EPA, 2017). This long-term data suggests an upper average concentration of no more than 15 µg/m^3. Dún Laoghaire is the most representative monitoring station with an upper average limit of no more than 14 µg/m^3. Based on the EPA data (Table 8- 3: Trends In Trends In Zone A Air Quality - PM_{10}) a conservative estimate of the current background PM_{10} concentration in the region of the proposed scheme is 15 µg/m^3.

Table 8- 3: Trends In Trends In Zone A Air Quality - PM_{10}

Year	Winetavern Street	Rathmines	Dún Laoghaire	Tallaght
2012	13	14	12	-
2013	14	17	17	17
2014	14	14	14	15
2015	14	15	13	14
2016	14	15	13	14
Average	**13.8**	**15.0**	**13.8**	**15.1**

Continuous $PM_{2.5}$ monitoring carried out at the Zone A location of Rathmines showed average levels of 9 – 11 µg/m^3 over the 2012 - 2016 period, with a $PM_{2.5}/PM_{10}$ ratio ranging from 0.64 – 0.79. In the absence of $PM_{2.5}$ data from the most representative station in Dún Laoghaire, a conservative ratio of 0.8 based on data from Rathmines was used to generate a current background $PM_{2.5}$ concentration in the region of the proposed scheme of 12 µg/m^3.

In terms of benzene, the annual mean concentration in the Zone A monitoring location of Rathmines for 2016 was 1.01 µg/m^3. This is well below the limit value of 5 µg/m^3. Between 2012 - 2016 annual mean concentrations at Zone A sites ranged from 0.92 – 1.2 µg/m^3. Based on this EPA data a conservative estimate of the current background benzene concentration in the region of the proposed scheme is 1.0 µg/m^3.

With regard to CO, annual averages at the Zone A locations of Winetavern Street and Coleraine Street over the 2012 – 2016 period are low, peaking at 5% of the limit value (10 mg/m^3) (EPA, 2017a). Based on this EPA data, a conservative estimate of the current background CO concentration in the region of the proposed scheme is 0.5 mg/m^3.

Background concentrations for the Opening (2020) and Design (2035) years are calculated using estimated current background concentrations and the year on year reduction factors provided by Transport Infrastructure Ireland in the *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (2011) and the UK Department for Environment, Food and Rural Affairs LAQM.TG(16) (2016a).

8.4 Predicted Impacts

The scheme has an opening year of 2020. 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.

During the construction stage the main source of air quality impacts will be as a result of fugitive dust emissions from site activities. Emissions from construction vehicles and machinery have the potential to impact climate. 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.

The following describes the primary sources of potential air quality and climate impacts which have been assessed as part of this EIAR.

8.4.1 Do Nothing Scenario

The Do Nothing scenario includes retention of the current sites without the proposed scheme. In this scenario, ambient air quality in the area will remain as per the baseline and will change in accordance with trends within the wider area (including influences from potential new developments in the surrounding area, changes in road traffic, etc).

The Do Nothing scenario for the operational phase of the proposed scheme is assessed under the operation phase local air quality impact assessment.

8.4.2 Construction Phase

8.4.2.1 Air Quality

The greatest potential impact on air quality during the construction phase of the proposed scheme 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. As this is a moderate scale development there is the potential for soiling impacts up to 50m from the source (Table 8- 4: Assessment Criteria for the Impact of Dust from Construction, with Standard Mitigation in Place (TII, 2011) (TII, 2011).

There are a number of sensitive receptors, predominantly residential properties along the length of the proposed scheme in close proximity to potential works areas. Due to the nature of the scheme, potential impacts as a result of construction dust emissions will be short-term and temporary in nature. In order to minimise dust emissions during construction, a series of mitigation measures have been prepared in the form of a dust minimisation plan. Provided the dust minimisation measures outlined in the plan (see Appendix 8.3) are adhered to, the air quality impacts during the construction phase will not be significant. These measures are summarised in the mitigation section of this chapter.

Table 8- 4: Assessment Criteria for the Impact of Dust from Construction, with Standard Mitigation in Place (TII, 2011)

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

8.4.2.2 Climate

There is the potential for a number of greenhouse gas emissions to atmosphere during the construction of the proposed scheme. Construction vehicles, generators etc., may give rise to CO_2 and N_2O emissions. However, the impact on climate is considered to be **imperceptible** in the **long and short term**.

8.4.2.3 Human Health

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

8.4.3 Operational Phase

8.4.3.1 Local Air Quality

There is the potential for a number of emissions to the atmosphere during the operational phase of the scheme. 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 traffic engineers for this project and has been used to model pollutant levels under various traffic scenarios and under sufficient spatial resolution to assess whether any significant air quality impact on sensitive receptors may occur.

Cumulative effects have been assessed, as recommended in the EU Directive on EIA (Council Directive 2014/52/EU) and using the methodology of the UK DEFRA (2016a; 2016b). Firstly, background concentrations have been included in the modelling study. These background concentrations are year-specific and account for non-localised sources of the pollutants of concern. Appropriate background levels were selected based on the available monitoring data provided by the EPA (EPA, 2017a; 2018).

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

The receptors modelled represent the worst-case locations close to the proposed scheme and were chosen due to their close proximity (within 200m) to the road links impacted by proposed scheme. The worst-case traffic data used in this assessment is shown in Table 8- 5: Traffic Data used in Modelling Assessment, with the percentage of HGV's shown in parenthesis below the AADT. Nine sensitive receptors in the vicinity of the proposed scheme have been assessed. Sensitive receptors have been chosen as they have the potential to be adversely impacted by the development, these receptors are detailed in Table 8- 6: Description of Sensitive Receptors.

Table 8- 5: Traffic Data used in Modelling Assessment

Link Number	Road Name	Base Year	Do-Nothing		Do-Something		Speed (kph)
		2017	**2020**	**2035**	**2020**	**2035**	
1	Glenamuck Rd South (E)	12300 (4.4%)	13350 (5.3%)	17800 (7.6%)	2700 (1.7%)	5000 (1.8%)	50
2	R117 Enniskerry Rd (N)	7650 (3.7%)	9000 (4%)	14500 (5.1%)	11950 (3%)	16250 (4.4%)	50
3	Glenamuck Rd South (W)	9000 (2.7%)	10450 (3.1%)	13900 (4.8%)	1900 (2.2%)	5750 (3.2%)	50
4	R117 Enniskerry Rd (S)	8350 (4.6%)	10500 (5%)	16900 (6.2%)	1400 (1.1%)	2050 (1.5%)	50
5	Barnaslingan Lane	350 (1.6%)	500 (1.4%)	800 (1.1%)	500 (1.4%)	800 (1.5%)	50
6	R116 Ballycorus Rd	2200 (2.7%)	4050 (2.7%)	7100 (3.3%)	4950 (2.4%)	11600 (2.9%)	50
7	Glenamuck District Distributor Rd (E)	0 (0%)	0 (0%)	0 (0%)	13200 (6.3%)	26600 (8.6%)	50
8	Glenamuck District Distributor Rd (E) Junct GLDR	0 (0%)	0 (0%)	0 (0%)	1400 (5.6%)	26450 (8.7%)	50
9	Glenamuck District Distributor Rd (W)	0 (0%)	0 (0%)	0 (0%)	7250 (3.2%)	14250 (6%)	50
10	Glenamuck Link Distributor Rd (N)	0 (0%)	0 (0%)	0 (0%)	12550 (4.3%)	21600 (5.4%)	50
11	R117 Enniskerry Rd Junct Glenamuck Rd South	0 (0%)	9050 (4%)	14600 (4%)	4700 (2.7%)	5800 (3.2%)	50
12	Glenamuck Link Distributor Rd (S)	0 (0%)	0 (0%)	0 (0%)	10850 (5%)	20450 (4.7%)	50
13	Glenamuck Link Distributor Rd south of Ballycorus Rd	0 (0%)	0 (0%)	0 (0%)	11900 (4.4%)	16800 (4.8%)	50

Table 8- 6: Description of Sensitive Receptors

Receptor	Type	Irish Grid Coordinates	
		Easting	Northing
1	Residential	321566	223653
2	Residential	320772	223051
3	Residential	320286	223186
4	School	320212	222871
5	Residential	320647	222667
6	Sports Club	320944	222750
7	Residential	320961	222146
8	Residential	320937	221940
9	Residential	320996	221758

Modelling Assessment

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

"Do Nothing" (DN) Scenario

<u>NO_2</u>

The results of the "do nothing" assessment of annual average NO_2 concentrations in the opening and design years are shown in Table 8- 7: Annual Mean NO_2 Concentrations (μg/m^3) (using Interim advice note 170/12 V3 Long Term NO_2 Trend Projections) for the Highways Agency IAN 170/12 and Table 8- 8: Annual Mean NO_2 Concentrations (μg/m^3) (using UK Department for Environment, Food and Rural Affairs Technical Guidance) 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. Concentrations are below the limit value at all locations, with levels ranging from 56% of the limit in the opening year (2020) and 58% in the design year (2035) using the more conservative IAN 170/12 V3 method.

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 concentrations for the "do nothing" scenario is not predicted to be exceeded in 2020 or 2035 (see Table 8- 9: 99.8th percentile of daily maximum 1-hour for NO_2 concentrations (μg/m^3)).

<u>PM_{10}</u>

The results of the "do nothing" modelling assessment for PM_{10} in the opening and design years are shown in Table 8- 10: Annual Mean PM_{10} Concentrations (μg/m³). Concentrations are well within the annual limit value at all worst-case receptors. In addition, the 24-hour PM_{10} concentration of 50 μg/m³ is not exceeded at the receptors modelled (Table 8- 11: Number of days with PM_{10} concentration > 50 μg/m³). Annual average PM_{10} concentrations are 38.9% of the limit value in 2020 and 39.6% in 2035.

$PM_{2.5}$

The results of the "do nothing" modelling assessment for $PM_{2.5}$ in the opening and design years are shown in Table 8- 12: $PM_{2.5}$ Annual Mean $PM_{2.5}$ Concentrations (μg/m³). The predicted concentrations at all worst-case receptors are well below the $PM_{2.5}$ limit value of 25 μg/m³. The annual average $PM_{2.5}$ concentration peaks at 41% of the limit value in 2020 and 2035.

CO and Benzene

The results of the modelled impact for CO and benzene in the opening and design years are shown in Table 8- 13: Maximum 8-hour CO Concentrations (mg/m³) and Table 8- 14: Annual Mean Benzene Concentrations (μg/m³) respectively. The results for the "do nothing" assessment are below the ambient standards at all locations. Levels of CO are 28% of the limit value in 2020; with levels of benzene reaching 21% of the limit value. Future trends indicate similarly low levels of CO and benzene. Levels of both pollutants are below their respective limit values, with CO reaching 25% of the limit and benzene reaching 22% in 2030.

There are some increases in traffic volumes between 2020 and 2035 therefore, any decrease in concentrations is as a result of decreasing background concentrations and better engine efficiency and technology.

"Do Something" (DS) Scenario

NO_2

The results of the assessment of the impact of the proposed scheme on NO_2 in the opening and design years are shown Table 8- 7: Annual Mean NO_2 Concentrations (μg/m³) (using Interim advice note 170/12 V3 Long Term NO_2 Trend Projections) for the Highways Agency IAN 170/12 and Table 8- 8: Annual Mean NO_2 Concentrations (μg/m³) (using UK Department for Environment, Food and Rural Affairs Technical Guidance) using the UK Department for Environment, Food and Rural Affairs technique respectively. The annual average concentration is within the limit value at all worst-case receptors using both techniques. Levels of NO_2 are 57.9% and 67.9% of the annual limit value in 2020 and 2035 using the more conservative IAN technique, while concentrations are 47.7% and 47.6% of the annual limit value in 2020 and 2035 using the UK Department for Environment, Food and Rural Affairs technique. The hourly limit value for NO_2 is 200 μg/m³ and is expressed as a 99.8^{th} percentile (i.e. it must not be exceeded more than 18 times per year). The maximum 1-hour NO_2 concentration is not predicted to be exceeded in 2020 or 2035 using either technique (Table 8- 9: 99.8^{th} percentile of daily maximum 1-hour for NO_2 concentrations (μg/m³)).

The impact of the proposed scheme on annual mean NO_2 levels can be assessed relative to "Do Nothing (DN)" levels in 2020 and 2035. Relative to baseline levels, some large increases in pollutant levels are predicted as a result of the proposed scheme. With regard to impacts at individual receptors, the greatest impact on NO_2 concentrations will be an increase of 23% of the annual limit value at Receptor 7. Thus, using the assessment criteria outlined in Appendix 8.2 Tables A.8.2.1 – A.8.2.2, the impact of the proposed development in terms of NO_2 is slight adverse. However, there are a number of receptors that will receive a beneficial impact with the development of the proposed scheme; there will be a decrease of at least 6% of the limit value at Receptors 1 and 5 along the R842 once the proposed scheme is developed which according to the criteria in Appendix 8.2, Tables A.8.2.1 – A.8.2.2 results in a slight beneficial rating.

Therefore, the overall impact of NO_2 concentrations as a result of the proposed scheme is **long-term** and **slight negative** at the majority of receptors along the proposed route, but with a **slight beneficial** impact at receptors located in bypassed areas such as along the R117.

<u>PM_{10}</u>

The results of the modelled impact of the proposed scheme for PM_{10} in the opening and design years are shown in Table 8- 10: Annual Mean PM_{10} Concentrations (µg/m^3). Predicted annual average concentrations at the worst-case receptor in the region of the scheme are at most 39% of the limit value in 2020. Future trends with the proposed scheme in place indicate similarly low levels of PM_{10}. Annual average PM_{10} concentrations are 41% of the limit in 2035. Furthermore, it is not predicted that the worst-case receptors will have any exceedances of the 50 µg/m^3 24-hour mean value in 2020 or 2035 (Table 8- 11: Number of days with PM_{10} concentration > 50 µg/m^3).

The impact of the proposed development can be assessed relative to "Do Nothing" levels in 2020 and 2035 (see Table 8- 10: Annual Mean PM_{10} Concentrations (µg/m^3)). Relative to baseline levels, some small increases in PM_{10} levels at the worst-case receptors are predicted as a result of the proposed scheme. The greatest impact on PM_{10} concentrations in the region of the proposed scheme in either 2020 or 2035 will be an increase of 3.4% of the annual limit value at Receptor 7, which results in a negligible rating according to Appendix 8.2 Tables A.8.2.1 – A.8.2.3. However, there are some receptors for which the proposed scheme will result in a beneficial impact. There will be a decrease of at least 1% of the limit value at Receptors 1 and 5 on the R842, this equates to a negligible rating when assessed against the significance criteria in Appendix 8.2 Tables A.8.2.1 – A.8.2.2

Thus, the magnitude of the changes in air quality are negligible at all receptors based on the criteria outlined in Appendix 8.2 Tables A.8.2.1 – A.8.2.3. Therefore, the overall impact of PM_{10} concentrations as a result of the proposed scheme is **long-term** and **imperceptible**.

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

The results of the modelled impact of the proposed scheme for $PM_{2.5}$ in the opening and design years are shown in Table 8- 12: $PM_{2.5}$ Annual Mean $PM_{2.5}$ Concentrations (µg/m^3). Predicted annual average concentrations in the region of the proposed scheme are 41% of the limit value in 2020 at all worst-case receptors. Future trends with the development in place indicate similarly low levels of $PM_{2.5}$; annual average $PM_{2.5}$ concentrations are 42% of the limit in 2035.

The impact of the development can be assessed relative to "Do Nothing" levels in 2020 and 2035. Relative to baseline levels, small increases in $PM_{2.5}$ levels at the worst-case receptors are predicted as a result of the proposed scheme. The greatest impact on $PM_{2.5}$ concentrations in the region of the proposed scheme in either 2020 or 2035 will be an increase of 3.5% of the annual limit value at Receptor

7, which results in a negligible rating according to Appendix 8.2 Tables A8.2.1 – A.8.2.2. However, there are some receptors for which the proposed scheme will result in a beneficial impact. There will be a decrease of at least 1% of the limit value at Receptors 1 and 5, this equates to a negligible rating when assessed against the significance criteria in Appendix 8.2 Tables A.8.2.1 – A.8.2.2.

Therefore, using the assessment criteria outlined in Appendix 8.2 Tables A.8.2.1 – A.8.2.2, the impact of the proposed scheme with regard to $PM_{2.5}$ is negligible at all of the receptors assessed. Overall, the impact of increased $PM_{2.5}$ concentrations as a result of the proposed scheme is **long-term** and **imperceptible**.

<u>CO and Benzene</u>

The results of the modelled impact of the CO and benzene in the opening and design years are shown in Table 8- 13: Maximum 8-hour CO Concentrations (mg/m^3) and Table 8- 14: Annual Mean Benzene Concentrations (μg/m^3) respectively. Predicted pollutant concentrations with the proposed scheme in place are below the ambient standards at all locations. Levels of CO are 28% of the limit value in 2020; with levels of benzene reaching 21% of the limit value. Future trends indicate similarly low levels of CO and benzene. Levels of both pollutants are below their respective limit values, with CO reaching 25% of the limit and benzene reaching 22% in 2035. There are some increases in traffic flows between 2020 and 2035, therefore any reduction in concentrations is due to reduced background concentrations and greater efficiencies predicted in engines.

The impact of the proposed development can be assessed relative to "Do Nothing" levels in 2020 and 2035. Relative to baseline levels, some imperceptible increases in pollutant levels at the worst-case receptors are predicted as a result of the proposed scheme. The greatest impact on CO and benzene concentrations in either 2020 or 2035 will be an increase of 3.8% of the limit value for CO at Receptor 7 and an increase of 2.0% of the limit value for benzene at Receptor 7. Any beneficial impacts as a result of the proposed scheme with regard to CO and benzene are also considered imperceptible.

Thus, using the assessment criteria for NO_2 and PM_{10} outlined in Appendix 8.2 and applying these criteria to CO and benzene, the impact of the proposed scheme in terms of CO and benzene is **negligible**, **long-term** and **imperceptible**.

Summary of Local Air Quality Modelling Assessment

Levels of traffic-derived air pollutants for the development will not exceed the ambient air quality standards either with or without the proposed scheme in place. Using the assessment criteria outlined in Appendix 8.2 Tables A.8.2.1 – A.8.2.3, the impact of the development in terms of NO_2, is **slight negative** at the majority of receptors along the proposed route but is there is a **slight positive** impact in bypassed areas such as the R842. In terms of all other pollutants: PM_{10}, $PM_{2.5}$, CO and benzene the impact is considered imperceptible and long-term.

Impact on Regional Air Quality

The regional impact of the proposed development on emissions of NO_x and VOCs has been assessed using the procedures of Transport Infrastructure Ireland (2011) and the UK Department for Environment, Food and Rural Affairs (2016a). The results (see Table 8- 15: Regional Air Quality & Climate Assessment) show that the likely impact of the proposed scheme 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 2020, the predicted impact of the changes in AADT is to increase NO_x levels by 0.0022% of the NO_x emissions ceiling and increase VOC levels by 0.00088% of the VOC emissions ceiling to be complied with in 2020. For the assessment year of 2035, the predicted impact of the changes in AADT is to increase NO_x levels by 0.012% of the NO_x emissions ceiling and increase VOC levels by 0.0035% of the VOC emissions ceiling to be complied with in 2035.

8.4.3.2 Climate

The impact of the proposed scheme on emissions of CO_2 were also assessed using the Design Manual for Roads and Bridges screening model (see Table 8- 15: Regional Air Quality & Climate Assessment). The results show that the impact of the proposed scheme in 2020 will be to increase CO_2 emissions by 0.0017% of Ireland's EU 2020 Target. In the design year of 2035, the proposed scheme will increase CO_2 emissions by 0.006% of the EU 2020 Target. Thus, the impact of the proposed scheme on national greenhouse gas emissions will be insignificant in terms of Ireland's obligations under the EU 2020 Target (EU, 2017).

Therefore, the likely overall magnitude of the changes on climate in the operational stage are **imperceptible**, **long-term** and **not significant**.

Table 8- 7: Annual Mean NO_2 Concentrations (µg/m³) (using Interim advice note 170/12 V3 Long Term NO_2 Trend Projections)

Receptor	Impact Opening Year (2020)					Impact Design Year (2035)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	22.4	18.4	-3.96	Medium	Medium Decrease	23.3	17.9	-5.34	Large	Large Decrease
2	17.6	18.9	1.28	Small	Small Increase	16.4	18.7	2.33	Medium	Medium Increase
3	18.8	20.1	1.26	Small	Small Increase	18.8	21.3	2.51	Medium	Medium Increase
4	18.0	17.7	-0.38	Imperceptible	Negligible Decrease	17.2	16.4	-0.81	Small	Small Decrease
5	20.1	17.5	-2.55	Medium	Medium Decrease	20.5	17.2	-3.28	Medium	Medium Decrease
6	17.5	18.6	1.11	Small	Small Increase	16.2	18.1	1.95	Small	Small Increase
7	18.3	23.2	4.83	Large	Large Increase	18.0	27.2	9.14	Large	Large Increase
8	19.4	18.4	-1.02	Small	Small Decrease	19.6	17.4	-2.18	Medium	Medium Decrease
9	20.3	19.1	-1.17	Small	Small Decrease	21.1	18.5	-2.62	Medium	Medium Decrease

Table 8- 8: Annual Mean NO_2 Concentrations (µg/m³) (using UK Department for Environment, Food and Rural Affairs Technical Guidance)

Receptor	Impact Opening Year (2020)					Impact Design Year (2035)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	19.2	15.8	-3.39	Medium	Medium Decrease	17.7	13.7	-4.07	Large	Large Decrease
2	14.5	15.5	1.05	Small	Small Increase	11.4	13.0	1.62	Small	Small Increase
3	15.6	16.7	1.05	Small	Small Increase	13.4	15.2	1.79	Small	Small Increase
4	14.9	14.6	-0.31	Imperceptible	Negligible Decrease	12.1	11.5	-0.57	Small	Small Decrease
5	16.9	14.7	-2.14	Medium	Medium Decrease	15.0	12.6	-2.40	Medium	Medium Decrease
6	14.3	15.2	0.91	Small	Small Increase	11.2	12.5	1.35	Small	Small Increase
7	15.1	19.1	3.98	Medium	Medium Increase	12.6	19.0	6.40	Large	Large Increase
8	16.2	15.3	-0.85	Small	Small Decrease	14.1	12.5	-1.57	Small	Small Decrease
9	17.0	16.0	-0.98	Small	Small Decrease	15.4	13.5	-1.91	Small	Small Decrease

Table 8- 9: 99.8th percentile of daily maximum 1-hour for NO_2 concentrations (µg/m³)

Receptor	IAN 170/12 V3 Long Term NO_2 Trend Projections Technique				Defra's Technical Guidance Technique			
	Impact Opening Year (2020)		Impact Design Year (2035)		Impact Opening Year (2020)		Impact Design Year (2035)	
	DN	DS	DN	DS	DN	DS	DN	DS
1	78.3	64.5	81.5	62.8	78.3	64.5	81.5	62.8
2	61.6	66.1	57.4	65.6	61.6	66.1	57.4	65.6
3	65.8	70.2	65.9	74.7	65.8	70.2	65.9	74.7
4	63.2	61.8	60.3	57.5	63.2	61.8	60.3	57.5
5	70.3	61.4	71.6	60.1	70.3	61.4	71.6	60.1
6	61.1	65	56.6	63.4	61.1	65	56.6	63.4
7	64.2	81.1	63.1	95	64.2	81.1	63.1	95
8	67.9	64.3	68.7	61	67.9	64.3	68.7	61
9	70.9	66.8	73.9	64.8	70.9	66.8	73.9	64.8

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

Receptor	Impact Opening Year (2020)					Impact Design Year (2035)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	15.6	15.0	-0.62	Small	Small Decrease	15.9	15.2	-0.68	Small	Small Decrease
2	14.7	14.9	0.21	Imperceptible	Negligible Increase	14.7	15.0	0.32	Imperceptible	Negligible Increase
3	14.9	15.2	0.23	Imperceptible	Negligible Increase	15.1	15.5	0.36	Imperceptible	Negligible Increase
4	14.8	14.7	-0.06	Imperceptible	Negligible Decrease	14.8	14.7	-0.12	Imperceptible	Negligible Decrease
5	15.2	14.8	-0.44	Small	Small Decrease	15.4	15.0	-0.46	Small	Small Decrease
6	14.7	14.8	0.17	Imperceptible	Negligible Increase	14.7	14.9	0.27	Imperceptible	Negligible Increase
7	14.8	15.6	0.77	Small	Small Increase	15.0	16.3	1.35	Small	Small Increase
8	15.0	14.9	-0.15	Imperceptible	Negligible Decrease	15.2	14.9	-0.27	Imperceptible	Negligible Decrease
9	15.2	15.0	-0.17	Imperceptible	Negligible Decrease	15.5	15.1	-0.33	Imperceptible	Negligible Decrease

Table 8- 11: Number of days with PM_{10} concentration > 50 µg/m³

Receptor	Impact Opening Year (2020)		Impact Design Year (2035)	
	DN	DS	DN	DS
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0

Table 8- 12: $PM_{2.5}$ Annual Mean $PM_{2.5}$ Concentrations (µg/m³)

Receptor	Impact Opening Year (2020)					Impact Design Year (2035)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	10.1	9.7	-0.40	Small	Small Decrease	10.3	9.9	-0.44	Small	Small Decrease
2	9.5	9.7	0.13	Imperceptible	Negligible Increase	9.6	9.8	0.21	Imperceptible	Negligible Increase
3	9.7	9.8	0.15	Imperceptible	Negligible Increase	9.8	10.1	0.24	Imperceptible	Negligible Increase
4	9.6	9.6	-0.04	Imperceptible	Negligible Decrease	9.6	9.6	-0.07	Imperceptible	Negligible Decrease
5	9.9	9.6	-0.29	Imperceptible	Negligible Decrease	10.0	9.7	-0.30	Imperceptible	Negligible Decrease
6	9.5	9.6	0.11	Imperceptible	Negligible Increase	9.5	9.7	0.18	Imperceptible	Negligible Increase
7	9.6	10.1	0.50	Small	Small Increase	9.7	10.6	0.88	Small	Small Increase
8	9.8	9.7	-0.10	Imperceptible	Negligible Decrease	9.9	9.7	-0.18	Imperceptible	Negligible Decrease
9	9.9	9.8	-0.11	Imperceptible	Negligible Decrease	10.1	9.8	-0.21	Imperceptible	Negligible Decrease

Table 8- 13: Maximum 8-hour CO Concentrations (mg/m³)

Receptor	Impact Opening Year (2020)					Impact Design Year (2035)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	2.75	2.59	-0.169	Imperceptible	Negligible Decrease	2.81	2.64	-0.163	Imperceptible	Negligible Decrease
2	2.51	2.57	0.060	Imperceptible	Negligible Increase	2.51	2.60	0.087	Imperceptible	Negligible Increase
3	2.58	2.65	0.071	Imperceptible	Negligible Increase	2.62	2.72	0.099	Imperceptible	Negligible Increase
4	2.53	2.52	-0.016	Imperceptible	Negligible Decrease	2.55	2.52	-0.032	Imperceptible	Negligible Decrease
5	2.66	2.53	-0.130	Imperceptible	Negligible Decrease	2.71	2.59	-0.124	Imperceptible	Negligible Decrease
6	2.50	2.55	0.048	Imperceptible	Negligible Increase	2.50	2.57	0.075	Imperceptible	Negligible Increase
7	2.55	2.77	0.217	Imperceptible	Negligible Increase	2.59	2.97	0.376	Imperceptible	Negligible Increase
8	2.60	2.56	-0.040	Imperceptible	Negligible Decrease	2.65	2.58	-0.068	Imperceptible	Negligible Decrease
9	2.65	2.60	-0.044	Imperceptible	Negligible Decrease	2.72	2.64	-0.081	Imperceptible	Negligible Decrease

Table 8- 14: Annual Mean Benzene Concentrations (μg/m³)

Receptor	Impact Opening Year (2020)					Impact Design Year (2035)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	1.06	1.02	-0.037	Imperceptible	Negligible Decrease	1.07	1.04	-0.037	Imperceptible	Negligible Decrease
2	1.00	1.02	0.014	Imperceptible	Negligible Increase	1.00	1.03	0.024	Imperceptible	Negligible Increase
3	1.02	1.03	0.016	Imperceptible	Negligible Increase	1.03	1.05	0.024	Imperceptible	Negligible Increase
4	1.01	1.00	-0.004	Imperceptible	Negligible Decrease	1.01	1.00	-0.007	Imperceptible	Negligible Decrease
5	1.04	1.01	-0.030	Imperceptible	Negligible Decrease	1.05	1.02	-0.027	Imperceptible	Negligible Decrease
6	1.00	1.01	0.011	Imperceptible	Negligible Increase	1.00	1.02	0.020	Imperceptible	Negligible Increase
7	1.01	1.06	0.049	Imperceptible	Negligible Increase	1.02	1.12	0.100	Imperceptible	Negligible Increase
8	1.02	1.01	-0.009	Imperceptible	Negligible Decrease	1.03	1.02	-0.016	Imperceptible	Negligible Decrease
9	1.03	1.02	-0.010	Imperceptible	Negligible Decrease	1.05	1.03	-0.019	Imperceptible	Negligible Decrease

Table 8- 15: Regional Air Quality & Climate Assessment

Year	Scenario	VOC (kg/annum)	NO_x (kg/annum)	CO_2 (tonnes/annum)
2020	Do Nothing	2428	7795	4154
	Do Something	2839	9017	4855
2035	Do Nothing	3876	13032	6680
	Do Something	5362	17950	9239
Increment in 2020		411.2 kg	1222.5 kg	701.4 Tonnes
Increment in 2035		1486 kg	4918.3 kg	2559.7 Tonnes
Emission Ceiling (kilo Tonnes) 2020 [Note 1]		46.5	46.5	56.1
Emission Ceiling (kilo Tonnes) 2035 [Note 2]		42.2	42.2	27.5
Impact in 2020 (%)		0.00088 %	0.002 %	0.0017%
Impact in 2035 (%)		0.0035 %	0.018 %	0.0060 %

Note 1 Targets under Directive EU 2016/2284 "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

8.5 Mitigation Measures

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

8.5.1 Construction Phase

8.5.1.1 Air Quality

The pro-active control of fugitive dust will ensure the prevention of significant emissions, rather than an inefficient attempt to control them once they have been released. The main contractor will be responsible for the coordination, implementation and ongoing monitoring of the dust management plan. The key aspects of controlling dust are listed below. Full details of the dust management plan can be found in Appendix 8.3.

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

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

8.5.1.2 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 will not be significant.

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.

8.5.2 Operational Phase

8.5.2.1 Air Quality

Mitigation measures in relation to traffic-derived pollutants have focused generally on improvements in both engine technology and fuel quality. EU legislation, based on the EU sponsored Auto-Oil programmes, has imposed stringent emission standards for key pollutants (REGULATION (EC) No 715/2007) for passenger cars which was complied with in 2009 (Euro V) and 2014 (Euro VI).

As outlined in the TII guidance (2011), the guidance states that "for the purpose of the EIS, it should be assumed that pollutant concentrations will decline in future years, as a result of various initiatives to reduce vehicle emissions both in Europe and in Ireland" (Page 52). A range of legislation in Europe over the period 1992 – 2013 has significantly reduced the allowable steady cycle emissions of both NO_x and PM from road vehicles with NO_x emission reductions for HDV (Heavy Duty Vehicles) reduced by a factor of 20 and PM by a factor of 36 over this period (Euro I to Euro VI). In relation to LDV (Light Duty Vehicles) the reduction of NO_x and PM from road vehicles has also been significant with NO_x emission reductions from HDV reducing by a factor of 12 and PM by a factor of 40 over this period (Euro I to Euro VI). Although actual on-road emission reductions will be less dramatic, significant reductions in vehicle-related NO_x and PM emissions are to be expected over the next 5-10 years as the fleet turns over.

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 (UK DEFRA, 2016a, 2016b).

8.5.2.2 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 fueled vehicles and the introduction of cleaner fuels.

CO_2 emissions for the average new car fleet were reduced to 120 g/km by 2012 through EU legislation on improvements in vehicle motor technology and by an increased use of biofuels. This measure has reduced CO_2 emissions from new cars by an average of 25% in the period from 1995 to 2008/2009 whilst 15% of the necessary effort towards the overall climate change target of the EU has been met by this measure alone (DEHLG, 2007).

Additional measures included in the National Climate Change Strategy (DEHLG, 2000, 2006, 2007) include: (1) VRT and Motor Tax rebalancing to favour the purchase of more fuel-efficient vehicles with lower CO_2 emissions; (2) continuing the Mineral Oils Tax Relief II Scheme and introduction of a biofuels obligation scheme; (3) implementation of a national efficient driving awareness campaign, to promote smooth and safe driving at lower engine revolutions; and (4) enhancing the existing mandatory vehicle labelling system to provide more information on CO_2 emission levels and on fuel economy.

8.5.3 Monitoring

There is no monitoring required for the proposed scheme.

8.6 Residual Impacts

8.6.1 Construction Phase

8.6.1.1 Air Quality

When the dust minimisation measures detailed in the mitigation section and Appendix 8.3 of this Section are implemented, fugitive emissions of dust from the site will be insignificant and pose no nuisance at nearby receptors.

8.6.1.2 Climate

Due to the size and nature of the construction activities with appropriate mitigation measures, CO_2 and N_2O emissions during construction will have an imperceptible impact on climate.

8.6.2 Operational Phase

The results of the air dispersion modelling study indicate that the residual impacts of the proposed development on air quality and climate is predicted to be slight adverse with respect to the operational phase for the long and short term.

8.7 Difficulties Encountered

There were no difficulties encountered as part of this assessment.

8.8 References

- BRE (2003) Controlling Particles, Vapours & Noise Pollution From Construction Sites ;
- Department of the Environment, Heritage and Local Government (DEHLG) (2000) National Climate Change Strategy;
- Department of the Environment, Heritage and Local Government (DEHLG) (2004) National Programme for Ireland under Article 6 of Directive 2001/81/EC for the Progressive Reduction of National Emissions of Transboundary Pollutants by 2010;
- Department of the Environment, Heritage and Local Government (DEHLG) (2006) Ireland's Pathway to Kyoto Compliance – Review of the National Climate Change Strategy;
- Department of the Environment, Heritage and Local Government (DEHLG) (2007) National Climate change Strategy 2007 – 2012;
- Department of the Environment, Heritage and Local Government (DEHLG) (2007) Update and Revision of the National Programme for Ireland under Article 6 of Directive 2001/81/EC for the Progressive Reduction of National Emissions of Transboundary Pollutants by 2010;
- Department of the Environment, Heritage and Local Government (DEHLG) (2010) Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities;
- Environmental Protection Agency (2002) Guidelines On Information To Be Contained in Environmental Impact Statements;
- Environmental Protection Agency (2003) Advice Notes On Current Practice (In The Preparation Of Environmental Impact Statements);
- Environmental Protection Agency (2015) Advice Notes for Preparing Environmental Impact Statements – Draft;
- Environmental Protection Agency (2017a) Air Quality Monitoring Report 2016 (& previous annual reports 2011 - 2015);
- Environmental Protection Agency (2017b) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports – Draft;
- Environmental Protection Agency (2018) Air Monitoring Data (http://www.epa.ie/air/quality/monitor/);
- ERM (1998) Limitation and Reduction of CO_2 and Other Greenhouse Gas Emissions in Ireland;
- EU (2014) EU 2030 Climate and Energy Framework;
- EU (2017) Ireland's Final Greenhouse Gas Emissions in 2015;
- European Commission (2014) A policy framework for climate and energy in the period from 2020 to 2030;

- European Economic Area (2012) NEC Directive Status Reports 2011;
- IAQM (2014) Guidance on the Assessment of Dust from Demolition and Construction;
- The Scottish Office (1996) Planning Advice Note PAN50 Annex B: Controlling The Environmental Effects Of Surface Mineral Workings Annex B: The Control of Dust at Surface Mineral Workings;
- Transport Infrastructure Ireland (2011) Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes;
- Transport Infrastructure Ireland (TII) (2009) Guidelines for Assessment of Ecological Impacts of National Roads Schemes (Rev. 2, Transport Infrastructure Ireland, 2009);
- UK DEFRA (2001) DMRB Model Validation for the Purposes of Review and Assessment;
- UK DEFRA (2011) Trends in NO_x and NO_2 emissions and ambient measurements in the UK;
- UK DEFRA (2017) NO_x to NO_2 Conversion Spreadsheet (Version 6.1);
- UK DEFRA (2016a) Part IV of the Environment Act 1995: Local Air Quality Management, LAQM.TG(16);
- UK DEFRA (2016b) Part IV of the Environment Act 1995: Local Air Quality Management, LAQM. PG(16);
- UK DETR (1998) Preparation of Environmental Statements for Planning Projects That Require Environmental Assessment - A Good Practice Guide, Appendix 8 - Air & Climate;
- UK Highways Agency (2007) Design Manual for Roads and Bridges Vol 11 Chapter 3, HA 207/07 (Document & Calculation Spreadsheet);
- UK Highways Agency (2012) Interim Advice Note 170/12 Updated air quality advice on the assessment of future NO_x and NO_2 projections for users of DMRB Volume 11, Section 3, Part 1 - Air Quality;
- UK Office of Deputy Prime Minister (2002) Controlling the Environmental Effects of Recycled and Secondary Aggregates Production Good Practice Guidance;
- UN Framework Convention on Climate Change (1997) Kyoto Protocol To The United Nations Framework Convention On Climate Change;
- UN Framework Convention on Climate Change (1999) Ireland - Report on the in-depth review of the second national communication of Ireland;
- USEPA (1997) Fugitive Dust Technical Information Document for the Best Available Control Measures;
- USEPA (1986) Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition (periodically updated); and

- World Health Organisation (2006) Air Quality Guidelines - Global Update 2005 (and previous Air Quality Guideline Reports 1999 & 2000).