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11

Air Quality

(including Odour)

Environmental Impact Assessment Report: Nua Bioenergy, Lisheen
P-2024-35-59

11.0 Air Quality & Odour

11.1 Introduction

This chapter of the EIAR was prepared to assess the potential significant effects on air quality of the proposed development of an anaerobic digestion facility to produce renewable biomethane and bio-based fertilizer at the former Lisheen Mine Site, Killoran, Moyne, Thurles, Co. Tipperary. The assessment of impacts has been undertaken in the context of current relevant standards and guidance, and identifies any requirements or possibilities for mitigation. A full description of the development can be found in **Chapter 6 Description of Proposed Development**.

Mitigation measures are included, where relevant, to ensure the proposed development is constructed in an environmentally sustainable manner in order to ensure minimal impact on the receiving environment.

In relation to air quality, impacts will occur during both the construction and operational phases of the development.

During the construction phase construction dust emission have the potential to affect air quality. Dust emissions will primarily occur as a result of site preparation works, earthworks and the movement of trucks on site and exiting the site. There is also the potential for engine emissions from site vehicles and machinery to affect air quality. Construction phase impacts will be short-term in duration.

Engine emissions from vehicles accessing the site have the potential to affect air quality during the operational phase of the development through the release of nitrogen dioxide (NO_2) and particulate matter [as PM_{10} and $PM_{2.5}$]. Process emissions of NO_2 and carbon monoxide [CO] from the Combined Heat and Power [CHP] generator and the emergency flare, and odour from the feedstock storage areas have the potential to affect air quality during the operational phase of the development. Operational phase effects will be long-term in duration.

This chapter was also prepared by Dr. Jovanna Arndt, a Senior Environmental Consultant in the Air Quality & Climate section of AWN Consulting. She holds a BSc. in Environmental Science and a Ph.D. in Atmospheric Chemistry from University College Cork. She is an Associate Member of both the Institute of Air Quality Management and the Institute of Environmental Sciences. She has been specialising in the area of air quality and climate over 7 years and has prepared air quality and climate assessments for inclusion within EIARs for residential developments such as Twenties Lane (Planning Application Ref: 22713), Cherrywood T13 (Planning Application Ref: DZ23A/0028), Corballis Donabate LRD (Planning Application Ref: LRD0017/S3), commercial and industrial developments by Dublin Airport Authority, Zoetis, Ipsen, Merck Millipore, Greener Ideas Limited and Abbvie, as well as renewable energy developments such as Codling Wind Park and the Cúil Na Móna Anaerobic Digestion Facility. She also specialises in assessing air quality impacts using air dispersion modelling of transportation schemes such as BusConnects Dublin, major Highways England Road schemes and major rail infrastructure in the form of High Speed 2 (HS2 in the UK). She has prepared air dispersion modelling assessments of emissions from data centres, energy centres and the chemical industry as part of Environmental Protection Agency [EPA] Industrial Emissions Licences for Microsoft, Greener Ideas Limited, Merck Millipore, Lilly Limerick, Chemifloc, Takeda, Kingspan and Kilshane Energy. She has also provided Air Quality Action Plan [AQAP] and Air Quality Management Area [AQMA] support to several UK councils and assessed the air quality impacts of potential Clean Air Zones in the UK.

11.2 Relevant Legislation, Policy and Guidance

The principal guidance and best practice documents used to inform the assessment of potential impacts on air quality are summarised below. The assessment has made reference to national guidelines where available, in addition to international standards and guidelines relating to the assessment of air quality impacts:

- *Guidance on the Assessment of Dust from Demolition and Construction v2.2 (Institute of Air Quality Management [IAQM]* (hereafter referred to as the IAQM Guidelines) (IAQM, 2024);
- *A Guide To The Assessment Of Air Quality Impacts On Designated Nature Conservation Sites* (Version 1.1) (IAQM, 2020);
- *Odour Emissions Guidance Note (AG9)* (EPA, 2019);
- *Air Dispersion Modelling from Industrial Installations Guidance Note (AG4)* (EPA, 2020)*;* and
- *PE-ENV-01106: Air Quality Assessment of Specified Infrastructure Projects* (Transport Infrastructure Ireland [TII], 2022).

In addition to specific air quality guidance documents, the following guidelines were considered and consulted in the preparation of this chapter:

- *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports* (hereafter referred to as the Environmental Protection Agency (EPA) Guidelines) (EPA, 2022);
- *Advice Notes on Current Practice in the Preparation of Environmental Impact Statements* (EPA, 2003);
- *Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment* (Department of Housing, Planning & Local Government, 2018); and
- *Environmental Impact Assessment (EIA) Directive Guidance on the Preparation of the Environmental Impact Assessment Report* (European Commission, 2017).

11.2.1 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.

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 2022 (S.I. No. 739 of 2022), which incorporate EU Directive 2008/50/EC, which has set limit values for a number of pollutants. The limit values for NO_2, PM_{10}, $PM_{2.5}$ and SO_2 are relevant to this assessment (see **Table 11.1**).

Pollutant	Regulation Note 1	Limit Type	Value Note 2
Dust Deposition	TA Luft (German VDI 2002)	Annual average limit for nuisance dust	350 mg/m^2/day
Nitrogen Oxides [NO_x]	2008/50/EC	Annual limit value for the protection of vegetation	30 µg/m^3 NO + NO_2
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
Particulate Matter [as PM_{10}]	2008/50/EC	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 µg/m^3 PM_{10}
		Annual limit for protection of human health	40 µg/m^3 PM_{10}
Particulate Matter [as $PM_{2.5}$] - Stage 1	2008/50/EC	Annual limit for protection of human health	25 µg/m^3 $PM_{2.5}$
Particulate Matter [as $PM_{2.5}$] - Stage 2 Note 3	2008/50/EC	Annual limit for protection of human health	20 µg/m^3 $PM_{2.5}$
Carbon Monoxide [CO]	2008/50/EC	Maximum 8-hour limit for protection of human health	10 mg/m^3

Table 11.1: Air Quality Standards Regulations and TA Luft.

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

Note 2 mg/m^3 [milligrams per cubic metre]; µg/m^3 [micrograms per cubic metre]

Note 3 Stage 2 indicative limit value for $PM_{2.5}$ to be applied from 1 January 2020 after review by the European Commission

In April 2023, the Government of Ireland published the *Clean Air Strategy for Ireland* (Government of Ireland, 2023), which provides a high-level strategic policy framework needed to reduce air pollution. The strategy commits Ireland to achieving the 2021 World Health Organisation [WHO] Air Quality Guidelines Interim Target 3 (IT3) by 2026 (shown in **Table 11.2**), the IT4 targets by 2030 and the final targets by 2040 (shown in **Table 11.2**). The strategy notes that a significant number of Environmental Protection Agency [EPA] monitoring stations observed air pollution levels in 2021 above the WHO targets; 80% of these stations would fail to meet the final $PM_{2.5}$ target of 5 µg/m^3. The strategy also acknowledges that *"meeting the WHO targets will be challenging and will require legislative and societal change, especially with regard to both $PM_{2.5}$ and NO_2"*. Ireland will revise its air quality legislation in line with the proposed EU revisions to the EU 2008/50/EC – Clean Air For Europe (CAFE) Directive, which will set interim 2030 air quality standards and align the EU more closely with the WHO targets.

At present, the applicable air quality assessment criteria for the proposed development are the Ambient Air Quality Standards set under Directive 2008/50/EC and shown in **Table 11.1**.

Pollutant	Limit Type	IT3 (2026)	IT4 (2030)	Final Target (2040)
NO_2	24-hour limit for protection of human health	-	-	25 µg/m³ NO_2
	Annual limit for protection of human health	20 µg/ m³ NO_2	-	10 µg/m³ NO_2
PM (as PM_{10})	24-hour limit for protection of human health	75 µg/ m³ PM_{10}	50 µg/m³ PM_{10}	45 µg/m³ PM_{10}
	Annual limit for protection of human health	30 µg/ m³ PM_{10}	20 µg/m³ PM_{10}	15 µg/m³ PM_{10}
PM (as $PM_{2.5}$)	24-hour limit for protection of human health	37.5 µg/m³ $PM_{2.5}$	25 µg/m³ $PM_{2.5}$	15 µg/m³ $PM_{2.5}$
	Annual limit for protection of human health	15 µg/m³ $PM_{2.5}$	10 µg/m³ $PM_{2.5}$	5 µg/m³ $PM_{2.5}$

Table 11.2: WHO Air Quality Guidelines 2021.

11.2.2 Dust Deposition Guidelines

The concern from a health perspective is focused on particles of dust which are less than 10 microns [PM_{10}] and less than 2.5 microns [$PM_{2.5}$] and the EU ambient air quality standards outlined in **Table 11.1** have set ambient air quality limit values for PM_{10} and $PM_{2.5}$.

With regards to larger dust particles that can give rise to nuisance dust, there are no statutory guidelines regarding the maximum dust deposition levels that may be generated during the construction phase of a development in Ireland. Furthermore, no specific criteria have been stipulated for nuisance dust in respect of this development. With regard to dust deposition, the German TA-Luft standard for dust deposition (non-hazardous dust) (German VDI, 2002) sets a maximum permissible emission level for dust deposition of 350 mg/m²/day averaged over a one year period at any receptors outside the site boundary. Recommendations from the Department of the Environment, Heritage & Local Government (DEHLG, 2004) apply the TA Luft limit of 350 mg/m²/day to the site boundary of quarries. This limit value can also be implemented with regard to dust effects from construction of the proposed development.

11.2.3 Odour Emissions

The proposed development will generate odour from its various feedstock storage areas. Potential odour impacts from the various digestor tanks and biofertilizer processing plant and storage are not considered significant and have been scoped out of this assessment. These sources are connected to an Odour Treatment System designed to manage odours from biogas and organic waste facilities – see Chapter 6 Description of the Proposed Development for details of the proposed development processes.

The following sections provide some background on odour as a pollutant and detail how the potential for odour impacts was assessed for the purpose of this EIAR. Odour dispersion modelling has been used to predict the impacts of the proposed development on the surrounding environment and the assessment has been conducted in compliance with the EPA guidance document titled *Air Dispersion Modelling from Industrial Installations Guidance Note (AG4)* (EPA, 2020). Further details of the dispersion modelling methodology and input data can be found in **Section 11.3.2.2**.

11.2.3.1 Defining and Describing Odour

Odours are sensations resulting from the reception of a stimulus by the olfactory sensory system, which consists of two separate subsystems: the olfactory epithelium and the trigeminal nerve. The olfactory epithelium, located in the nose, is capable of detecting and discriminating between many thousands of different odours and can detect some of them in concentrations lower than those detectable by currently available analytical instruments (Water Environment Federation, 1995). The function of the trigeminal nerve is to trigger a reflex action that produces a painful sensation. It can initiate protective reflexes such as sneezing to interrupt inhalation. The olfactory system is extremely complex and peoples' responses to odours can be variable. This variability is the result of differences in the ability to detect odour; subjective acceptance or rejection of an odour due to past experience; circumstances under which the odour is detected; and the age, health and attitudes of the human receptor.

Odour Intensity and Threshold

Odour intensity is a measure of the strength of the odour sensation and is related to the odour concentration. The odour threshold refers to the minimum concentration of an odorant that produces an olfactory response or sensation. This threshold is normally determined by an odour panel consisting of a specified number of people, and the numerical result is typically expressed as occurring when 50% of the panel correctly detect the odour. This odour threshold is given a value of one odour unit and is expressed as 1 OU_E/m^3 [odour unit equivalent per cubic metre].

The odour threshold is not a precisely determined value but depends on the sensitivity of the odour panellists and the method of presenting the odour stimulus to the panellists. An odour detection threshold relates to the minimum odorant concentration required to perceive the existence of the stimulus, whereas an odour recognition threshold relates to the minimum odorant concentration required to recognise the character of the stimulus.

Typically, the recognition threshold exceeds the detection threshold by a factor of 2 to 10 (AEA Technology, 1994; Water Environment Federation, 1995).

Odour Character

The character of an odour distinguishes it from another odour of equal intensity. Odours are characterised on the basis of odour descriptor terms (e.g. putrid, fishy, fruity etc.). Odour character is evaluated by comparison with other odours, either directly or through the use of descriptor words.

Hedonic Tone

The hedonic tone of an odour relates to its pleasantness or unpleasantness. When an odour is evaluated in the laboratory for its hedonic tone in the neutral context of an olfactometric presentation, the panellist is exposed to a stimulus of controlled intensity and duration. The degree of pleasantness or unpleasantness is determined by each panellist's experience and emotional associations. The responses among panellists may vary depending on odour character; an odour pleasant to many may be declared highly unpleasant by some.

Adaptation

Adaptation, or Olfactory Fatigue, is a phenomenon that occurs when people with a normal sense of smell experience a decrease in perceived intensity of an odour if the stimulus is received continually. Adaptation to a specific odorant typically does not interfere with the ability of a person to detect other odours. Another phenomenon known as habituation or occupational anosmia occurs when a worker in an industrial situation experiences a long-term exposure and develops a higher threshold tolerance to the odour.

11.2.3.2 Odour Guidelines

The exposure of the population to a particular odour consists of two factors; the concentration and the length of time that the population may perceive the odour. By definition, 1 OU_E/m^3 is the detection threshold of 50% of a qualified panel of observers working in an odour-free laboratory using odour-free air as the zero reference (the selection criteria result in the qualified panel being more sensitive to a particular odorant than the general population).

Currently there is no general statutory odour standard in Ireland relating to industrial installations. The EPA (EPA, 2001 and 2019) has issued guidance specific to intensive agriculture which has outlined the following standards:

- Target value for new pig-production units of 1.5 OU_E/m^3 as a 98th percentile of one hour averaging periods,
- Limit value for new pig-production units of 3.0 OU_E/m^3 as a 98th percentile of one hour averaging periods,
- Limit value for existing pig-production units of 6.0 OU_E/m^3 as a 98th percentile of one hour averaging periods.

Guidance from the UK (UKEA, 2011), and adapted for Irish EPA use, recommends that odour standards should vary from 1.5 – 6.0 OU_E/m^3 as a 98th percentile of one hour averaging periods at the worst-case sensitive receptor based on the offensiveness of the odour and with adjustments for local factors such as population density. A summary of the indicative criterion is provided in **Table 11.3** (taken from EPA Guidance document AG9 (EPA, 2019)).

The relevant exposure criteria vary from 1.5 OU_E/m^3 for highly odorous sources, 3.0 OU_E/m^3 for moderately odorous sources to 6.0 OU_E/m^3 for the least offensive odours. An anaerobic digestion facility with an odour abatement system is not included, but is likely to be of a medium to high offensiveness, and thus for this assessment it may be assumed that 1.5 OU_E/m^3 is the relevant exposure criteria as a worst-case.

Industrial Sectors	Relative Offensiveness of Odour	Indicative Criterion
Processes involving decaying animal or fish remains. Processes involving septic effluent or sludge. Waste sites including landfills, waste transfer stations and non-green waste composting facilities.	Most Offensive	1.5 OU_E/m^3 as a 98th percentile of hourly averages at the worst-case sensitive receptor
Intensive Livestock Rearing Fat Frying/Meat Cooking (Food Processing) Animal Feed Sugar Beet Processing Well aerated green waste composting Most odours from regulated processes fall into this category i.e., any industrial sector which does not obviously fall within the "most offensive" or "less offensive" categories.	Moderately Offensive	3.0 OU_E/m^3 as a 98th percentile of hourly averages at the worst-case sensitive receptor
Brewery/Grain/Oats Production Coffee Roasting Bakery Confectionery	Less Offensive	6.0 OU_E/m^3 as a 98th percentile of hourly averages at the worst-case sensitive receptor

Table 11.3: Indicative Odour Standards Based on Offensiveness of Odour and adapted for Irish EPA (Source: EPA, 2019).

11.3 Methodology

The following methodology has been adopted for this assessment:

- A detailed baseline air monitoring study has been undertaken in order to characterise the existing ambient environment in areas along the Proposed Development. This has been undertaken through a review of available published ambient air monitoring data applicable to the proposed development;
- A review of the most applicable standards and guidelines has been undertaken in order to define the air quality significance criteria for the construction and operational phases of the proposed development;
- An impact assessment relating to the likely construction phase air quality impacts has been undertaken at the nearest sensitive locations to the construction work areas associated with the proposed development;
- An impact assessment has been undertaken to assess the likely operational phase air quality impacts of traffic alterations associated with the operation of the proposed development at the most sensitive locations;
- An impact assessment has been undertaken to assess the likely operational phase air quality impacts of operational emissions to air from the facility at the most sensitive locations; and
- A schedule of mitigation measures has been incorporated where required, to reduce, where necessary, the identified potential air quality impacts associated with the proposed development.

11.3.1 Construction Phase Methodology

11.3.1.1 Construction Dust Assessment

The Institute of Air Quality Management in the UK (IAQM) guidance document *Guidance on the Assessment of Dust from Demolition and Construction* (2024) outlines an assessment method for predicting the impact of dust emissions from demolition, earthworks, construction and haulage activities based on the scale and nature of the works and the sensitivity of the area to dust impacts. The IAQM methodology has been applied to the construction phase of this development to predict the likely risk of dust impacts in the absence of mitigation measures and to determine the level of site-specific mitigation required. Transport Infrastructure Ireland (TII) recommends the use of the IAQM guidance (2024) in the TII guidance document *Air Quality Assessment of Specified Infrastructure Projects – PE-ENV-01106* (TII, 2022).

The major dust generating activities are divided into four types within the IAQM guidance (2024) to reflect their different potential impacts. These are:

- Demolition of existing structures;
- Earthworks;
- Construction of new structures; and
- Trackout (transport of dust and dirt from the construction site onto the public road network).

Earthworks refer to the processes of soil stripping, ground levelling, excavation and land capping, while track-out is the transport of dust and dirt from the site onto the public road network where it may be deposited and then re-suspended by vehicles using the network. This arises when vehicles leave the site with dusty materials, which may then spill onto the road, or when they travel over muddy ground on site and then transfer dust and dirt onto the road network.

For each of these dust-generating activities, the guidance considers three separate effects:

- Annoyance due to dust soiling;
- The risk of health effects due to a significant increase in PM_{10} exposure; and
- Harm to ecological receptors.

The receptors can be human or ecological and are chosen based on their sensitivity to dust soiling and PM_{10} exposure. The sensitive receptors are discussed in **Section 11.4.3.1**.

The main steps in the assessment are:

- For each category of construction (demolition, earthworks, construction and trackout):
  - Determine the sensitivity of the area (taking existing baseline conditions detailed in **Section 11.4.2** into account);
  - Determine the potential dust emission magnitude; and
  - Establish the risk of dust impacts.
- Detail any required site-specific mitigation; and
- Confirm any potential residual effects.

11.3.1.2 Construction Traffic Assessment

Construction phase traffic has the potential to impact air quality. The TII guidance Air Quality Assessment of Specified Infrastructure Projects – PE-ENV-01106 (TII, 2022), 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. While the guidance is specific to infrastructure projects, the approach can be applied to any development that causes a change in traffic.

- Annual average daily traffic [AADT] changes by 1,000 or more;
- Heavy duty vehicle [HDV] AADT changes by 200 or more;
- Daily average speed change by 10 kilometres per hour (kph) or more;
- Peak hour speed change by 20 kph or more;
- A change in road alignment by 5 metres or greater.

The traffic data provided for this assessment has been reviewed. As per the TII scoping criteria detailed above, it has been determined that the construction stage traffic will not increase by 1,000 AADT, or 200 HDV AADT. In addition, the proposed development will not result in speed changes or changes in road alignment. Therefore, the traffic does not meet the above scoping criteria. A detailed air quality assessment of construction stage traffic emissions has been scoped out from any further assessment as there is no potential for significant impacts to air quality.

11.3.2 Operational Phase Methodology

11.3.2.1 Operational Traffic Assessment

Operational phase traffic has the potential to impact air quality. The TII guidance Air Quality Assessment of Specified Infrastructure Projects – PE-ENV-01106 (TII, 2022), 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. While the guidance is specific to infrastructure projects, the approach can be applied to any development that causes a change in traffic.

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11.3.2.2 Air Dispersion Modelling

The proposed development will no generate additional process emissions from the facility during the operational phase. Existing emissions from the facility have been modelled to establish the existing baselines, or Do Nothing scenario, using the AERMOD dispersion model (Version 22112) which has been developed by the U.S. Environmental Protection Agency (USEPA) (USEPA, 2022) and following guidance issued by the EPA (EPA, 2020).

The model is a steady-state Gaussian plume model used to assess pollutant concentrations associated with industrial sources and has replaced ISCST3 (USEPA, 1995) as the regulatory model by the USEPA for modelling emissions from industrial sources in both flat and rolling terrain (USEPA, 1998; USEPA, 2000; USEPA, 2005). The model has more advanced algorithms and gives better agreement with monitoring data in extensive validation studies (USEPA, 1998; USEPA, 1999; Paine 1997a; Paine 1997b; Schulman, 2000). An overview of the AERMOD dispersion model is outlined in **EIAR Volume 3: Appendix 11.1**.

The air dispersion modelling input data consisted of information on the physical environment (including building dimensions and terrain features), design details from all emission points on-site and five years of appropriate hourly meteorological data. Using this input data the model predicted ambient ground level concentrations beyond the site boundary for each hour of the modelled meteorological years. The model post-processed the data to identify the location and maximum of the worst-case ground level concentration. This worst-case concentration was then added to the background concentration to give the worst-case predicted environmental concentration [PEC]. The PEC was then compared with the relevant ambient air quality standard to assess the significance of the releases from the site.

The modelling aims to achieve compliance with the guidance outlined within the EPA document *AG4 Guidance for Air Dispersion Modelling* (EPA, 2020) for the maximum permissible process contribution:

> "*When modelling a facility, the uncertainty in the model should be considered. If the facility is operated continually at close to the maximum licenced mass emission rate (i.e. maximum concentration and maximum volume flow) the process contribution (PC) should be less than 75% of the ambient air quality standard and less than this where background levels account for a significant fraction of the ambient air quality standard.*"

This approach allows for inherent uncertainty in air dispersion modelling to be taken into account in order to avoid a risk of exceeding the air quality standards. The modelling assessment has aimed to achieve a process contribution that is less than 75% of the ambient air quality standard under the Proposed Development scenario modelled (see **Section 11.3.2.2 Process Emissions** for details on modelling scenarios). As per Appendix K of AG4 (EPA, 2020) this states that gas engines/energy centres should be modelled using the standard methodology for continuous emission sources in line with the general AG4 guidance but it does not state that this is applicable to emergency operations. The standard AG4 approach has been applied to the boiler and CHP operating on natural gas in the Proposed Development scenario results have been modelled as compliant with the air quality standards for all relevant pollutants and below 75%.

Throughout this study a conservative approach was taken. This will most likely lead to an over-estimation of the levels that will arise in practice. The conservative assumptions are outlined below:

- Maximum predicted concentrations were reported in this study, even if no residential receptors were near the location of this maximum;
- Conservative background concentrations were used in the assessment;
- The effects of building downwash, due to on-site buildings, has been included in the model; and
- The main emission points (CHP generator and flare) were assumed to operate continuously for 24 hours a day, 365 days a year in all scenarios.

The United States Environmental Protection Agency (USEPA) approved AERMOD dispersion model has been used to predict the ground level concentrations [GLC] of compounds emitted from the principal emission sources on-site.

The modelling incorporated the following features:

- Modelled receptors included the proposed development boundary, gridded receptors and discrete sensitive receptors. These are described in more detail in **Section 11.4.3.2**;
- All on-site buildings and significant process structures were mapped into the computer to create a three dimensional visualisation of the site and its emission points. Buildings and process structures can influence the passage of airflow over the emission stacks and draw plumes down towards the ground (termed building downwash). The stacks themselves can influence airflow in the same way as buildings by causing low pressure regions behind them (termed stack tip downwash). Both building and stack tip downwash were incorporated into the modelling.
- Detailed terrain has been mapped into the model using SRTM data with 30m resolution. The site is located in an area of relatively simple terrain. All terrain features have been mapped in detail into the model using the terrain pre-processor AERMAP (USEPA, 2017).
- Hourly-sequenced meteorological information has been used in the model. Meteorological data over a five year period (Oak Park 2019 – 2023) was used in the model (see **Figure 11.1** and **EIAR Volume 3: Appendix 11.2**).
- The source and emissions data, including stack dimensions, gas volumes and emission temperatures have been incorporated into the model.

The Plume Volume Molar Ratio Method [PVMRM] was used to model NO_2 concentrations. The PVMRM is currently a non-regulatory option in AERMOD which assumes that the amount of NO converted to NO_2 is proportional to the ambient ozone concentration (Hanrahan, 1999a; Hanrahan, 1999b). The PVMRM uses both plume size and O_3 concentration to derive the amount of O_3 available for the reaction between NO and O_3. NO_X moles are determined by emission rate and travel time through the plume segment. The concentration is usually limited by the amount of ambient O_3 that is entrained in the plume. Thus, the ratio of the moles of O_3 to the moles of NO_X gives the ratio of NO_2/NO_X that is formed after the NO_X leaves the stack. In addition, it has been assumed that 20% of the NO_X in the stack gas is already in the form of NO_2 before the gas leaves the stack (in reality the levels are usually closer to 5% (Hanrahan, 1999a; Hanrahan, 1999b)). The model has also assumed a final equilibrium ratio for NO_2/NO_X of 0.90 which again is pessimistic and more likely to be in the range 0.7 – 0.8 (Hanrahan, 1999a; Hanrahan, 1999b). The equation used in the algorithm to derive the ratio of NO_2/NO_X gas combustion is:

$$NO_2/NO_X = (\text{moles } O_3/\text{ moles } NO_X) + 0.20^{\text{Note: 0.10 for liquid fuel}}$$

A background ozone concentration of 59 µg/m^3 was used in the modelling assessment, based on a review of worst case background ozone data for Zone D sites (EPA, 2023).

Terrain

The AERMOD air dispersion model has a terrain pre-processor AERMAP (USEPA, 2017) which was used to map the physical environment in detail over the receptor grid. The digital terrain input data used in the AERMAP pre-processor was obtained from SRTM. This data was run to obtain for each receptor point the terrain height and the terrain height scale. The terrain height scale is used in AERMOD to calculate the critical dividing streamline height,

H_{crit}, for each receptor. The terrain height scale is derived from the Digital Elevation Model (DEM) files in AERMAP by computing the relief height of the DEM point relative to the height of the receptor and determining the slope. If the slope is less than 10%, the program goes to the next DEM point. If the slope is 10% or greater, the controlling hill height is updated if it is higher than the stored hill height.

In areas of complex terrain, AERMOD models the impact of terrain using the concept of the dividing streamline (H_c). As outlined in the AERMOD model formulation (USEPA, 2022) a plume embedded in the flow below H_c tends to remain horizontal; it might go around the hill or impact on it. A plume above H_c will ride over the hill. Associated with this is a tendency for the plume to be depressed toward the terrain surface, for the flow to speed up, and for vertical turbulent intensities to increase. AERMOD model formulation states that the model :

> *"captures the effect of flow above and below the dividing streamline by weighting the plume concentration associated with two possible extreme states of the boundary layer (horizontal plume and terrain-following). The relative weighting of the two states depends on: 1) the degree of atmospheric stability; 2) the wind speed; and 3) the plume height relative to terrain. In stable conditions, the horizontal plume "dominates" and is given greater weight while in neutral and unstable conditions, the plume traveling over the terrain is more heavily weighted."* (USEPA, 2005).

Geophysical Considerations

AERMOD simulates the dispersion process using planetary boundary layer (PBL) scaling theory (USEPA, 2022). PBL depth and the dispersion of pollutants within this layer are influenced by specific surface characteristics such as surface roughness, albedo and the availability of surface moisture. Surface roughness is a measure of the aerodynamic roughness of the surface and is related to the height of the roughness element. Albedo is a measure of the reflectivity of the surface whilst the Bowen ratio is a measure of the availability of surface moisture.

AERMOD incorporates a meteorological pre-processor AERMET (USEPA, 2018) to enable the calculation of the appropriate parameters. The AERMET meteorological pre-processor requires the input of surface characteristics, including surface roughness (z_0), Bowen Ratio and albedo by sector and season, as well as hourly observations of wind speed, wind direction, cloud cover, and temperature. The values of albedo, Bowen Ratio and surface roughness depend on land-use type (e.g., urban, cultivated land etc) and vary with seasons and wind direction. The assessment of appropriate land-use type was carried out to a distance of 10 km from the meteorological station for Bowen Ratio and albedo and to a distance of 1 km for surface roughness in line with USEPA recommendations (USEPA, 2008; USEPA, 2018) as outlined in **EIAR Volume 3: Appendix 11.2**.

In relation to AERMOD, detailed guidance for calculating the relevant surface parameters has been published (USEPA, 2018). The most pertinent features are:

- The surface characteristics should be those of the meteorological site (Belmullet) rather than the installation;

- Surface roughness should use a default 1 km radius upwind of the meteorological tower and should be based on an inverse-distance weighted geometric mean. If land use varies around the site, the land use should be sub-divided by sectors with a minimum sector size of 30º;
- Bowen ratio and albedo should be based on a 10 km grid. The Bowen ratio should be based on an un-weighted geometric mean. The albedo should be based on a simple un-weighted arithmetic mean.

AERMOD has an associated pre-processor, AERSURFACE (USEPA, 2008) which has representative values for these parameters depending on land use type. The AERSURFACE pre-processor currently only accepts NLCD92 land use data which covers the USA. Thus, manual input of surface parameters is necessary when modelling in Ireland. Ordnance survey discovery maps (1:50,000) and digital maps such as those provided by the EPA, National Parks and Wildlife Service (NPWS) and Google Earth® are useful in determining the relevant land use in the region of the meteorological station. The Alaska Department of Environmental Conservation has issued a guidance note for the manual calculation of geometric mean for surface roughness and Bowen ratio for use in AERMET (ADEC, 2008). This approach has been applied to the current site with full details provided in **EIAR Volume 3: Appendix 11.2**.

Building Downwash

When modelling emissions from an industrial installation, stacks which are relatively short can be subjected to additional turbulence due to the presence of nearby buildings. Buildings are considered nearby if they are within five times the lesser of the building height or maximum projected building width (but not greater than 800 m).
The USEPA has defined the "Good Engineering Practice" (GEP) stack height as the building height plus 1.5 times the lesser of the building height or maximum projected building width. It is generally considered unlikely that building downwash will occur when stacks are at or greater than GEP (USEPA, 1985).

When stacks are less than this height, building downwash will tend to occur. As the wind approaches a building it is forced upwards and around the building leading to the formation of turbulent eddies. In the lee of the building these eddies will lead to downward mixing (reduced plume centreline and reduced plume rise) and the creation of a cavity zone (near wake) where re-circulation of the air can occur. Plumes released from short stacks may be entrained in this airflow leading to higher ground level concentrations than in the absence of the building.

The Plume Rise Model Enhancements (PRIME) (Paine, 1997a; Paine, 1997b) plume rise and building downwash algorithms, which calculates the impact of buildings on plume rise and dispersion, have been incorporated into AERMOD. The building input processor BPIP-PRIME produces the parameters which are required in order to run PRIME. The model takes into account the position of each stack relative to each relevant building and the projected shape of each building for 36 wind directions (at 10º intervals). The model determines the change in plume centreline location with downwind distance based on the slope of the mean streamlines and coupled to a numerical plume rise model (Paine, 1997a).

Given that the proposed stacks are less than 2.5 times the lesser of the building height or maximum projected building width, building downwash will need to be taken into account and the PRIME algorithm run prior to modelling with AERMOD. The dominant building for each relevant stack will vary as a function of wind direction and relative building heights.

Designated Habitat Sites

The impact of emissions of NO_X, nitrogen and acid deposition (as N) on ambient ground level concentrations within designated habitat sites within 20 km of the facility was assessed using AERMOD. The 20 km distance was selected based on maximum extent of the impact zone from the air emissions onsite. After 20 km, the ambient air concentration of NO_X, SO_2 and nutrient and acid deposition due to emissions from the facility are imperceptible.

Annual average concentrations for NO_X from all emission points at the facility were predicted at receptors within the designated sites for all five years of meteorological data modelled (2019 – 2023). With receptor spacing of 500 m, 418 discrete receptors were modelled in total within the sensitive ecosystems. The designated habitats modelled are detailed in **Section 11.4.3.2**.

In order to consider the effects of nitrogen (N) and acid deposition (as N) owing to emissions from the facility on the designated habitat sites, the maximum annual mean NO_2 predicted environmental concentrations must be converted firstly into a dry deposition flux using the equation below which is taken from UK Environment Agency publication *AGTAG06 – Technical Guidance On Detailed Modelling Approach For An Appropriate Assessment For Emissions To Air* (UKEA, 2014):

Dry deposition flux (µg/m²/s) = ground-level concentration (µg/m³) x deposition velocity (m/s)

The deposition velocities for NO_2 are outlined in AQTAG06 and shown below in **Table 11.4**. The dry deposition flux is then multiplied by the conversion factors shown in Table 6.3 (taken from AQTAG06) to convert it to a nitrogen (N) deposition flux (kg/ha/yr), and to an acid deposition (as N) flux (keq/ha/yr).

Chemical Species	Habitat Type	Recommended Deposition Velocity (m/s)	Nitrogen Deposition Conversion factor µg/m²/s to kg/ha/yr	Nitrogen Deposition to Acid Deposition Conversion factor kg/ha/yr to keq/ha/yr
NO_2	Grassland	0.0015	95.9	0.0714

Table 11.4 Dry Deposition Fluxes for NO_2.

Background concentrations for NO_X, nitrogen and acid deposition at the worst-case designated habitat were derived from the 1 km grid square concentrations provided on the Air Pollution Information System (APIS) website (APIS, 2023), in line with UKEA (2014) and UK Defra (2022) guidance. The background concentrations are added directly to the modelled NO_X and nitrogen deposition process contributions to give a total predicted environmental concentration.

Process Emissions

Dispersion modelling has been conducted to assess the off-site impacts from NO_X emissions from the CHP generator and emergency flare, as well as odour impacts from the feedstock storage areas.

The process emissions used in the modelling assessment, including stack heights for each source, are outlined in **Table 11.5** and **Table 11.6**. For the purposes of tis modelling assessment, the CHP plant and the flare were conservatively assumed to operate continuously all year round. Emissions data for the proposed CHP generator and flare as provided by Purser and based on specification sheets for the proposed plant provided by potential plant suppliers, as well as compliance with emission limit values in the Medium Combustion Plant (MCP) Regulations (S.I No. 595 of 2017), which transposed the Medium Combustion Plant Directive ((EU) 2015/2193) and applies to the individual plant in this case.

Stack Reference	Stack Location (UTM) Note 1	Height Above Ground Level (m)	Exit Diameter (m)	Temp (K)	Volume Flow (Nm^3/hr)	Exit Velocity (m/sec actual)
CHP generator	E588567, N5845245	6.39	0.70	694.15	22,572	24.56
Emergency flare	E588606, N5845304	7.575	2.45	1273.15	2,500	0.85
Storage clamp 1	E588671, N5845193	6	21.00	ambient	6,300	0.08
Storage clamp 2	E588692, N5845190	6	21.00	ambient	6,300	0.85
Storage clamp 3	E588713, N5845188	6	21.00	ambient	6,300	0.08
Enclosed storage building 1	E588606, N5845200	11.5	6.40	ambient	15,000	0.65
Enclosed storage building 2	E588626, N5845197	11.5	6.40	ambient	15,000	0.85

Table 11.5 Summary of process emission information for the facility.

Note 1 Emissions referenced to 273.15 K, 101.3 Pa, dry gas and 15% oxygen for the CHP and 3% oxygen for the flare. No correction required for the storage clamps and storage buildings.

Stack Reference	NO_X Concentration (mg/Nm^3) Note 1	NO_X Mass Emission (g/s)	CO Concentration (mg/Nm^3) Note 1	CO Mass Emission (g/s)	Odour Concentration (OU_E/Nm^3)	Odour Mass Emission (OU_E/s)
CHP generator	182	1.140	331	2.075	n/a	n/a
Emergency flare	150	0.104	50	0.104	n/a	n/a
Storage clamp 1	n/a	n/a	n/a	n/a	1000	1.750
Storage clamp 2	n/a	n/a	n/a	n/a	1000	1.750
Storage clamp 3	n/a	n/a	n/a	n/a	1000	1.750
Enclosed storage building 1	n/a	n/a	n/a	n/a	1000	4.167
Enclosed storage building 2	n/a	n/a	n/a	n/a	1000	4.167

Table 11.6 Summary of process emission concentrations for the facility.

Note 1 Emissions referenced to 273.15 K, 101.3 Pa, dry gas and 15% oxygen for the CHP and 3% oxygen for the flare. No correction required for the storage clamps and storage buildings.

The potential for cumulative impact of the emissions from the facility with Industrial Emissions (IE) licenced or Integrated Pollution Control (IPC) installations has been considered, in line with the methodology of AG4 (EPA, 2020). There is one EPA licenced installation near the facility, Lisheen Renewable Energy Limited (P1199-01 – licence in 'Applied' status), with the potential for cumulative impact with the proposed development. Additionally, the permitted Glanbia Biorefinery (planning application Ref. 18601296) will operate a CHP, 2 no. backup boilers and 3 no. dryers and will be subject to an IE licence in the future. However, no documentation is available with emissions information for these sources as part of the planning application. These sources could therefore not be included in the cumulative assessment. The non-technical summary for the Glanbia Biorefinery EIAR notes no impacts on air quality from the facility and therefore it is unlikely to result in a significant effect on air quality in combination with the proposed development and the Lisheen Renewable Energy Limited installation.

The process emissions used in the cumulative modelling assessment are outlined in **Table 11.7**. The CHP gas engines, boiler and flare were conservatively assumed to operate continuously 24 hours per day, 7 days per week as a worst-case.

Installation	Emission Source	Stack Height Above Ground Level (m)	Stack Exit Diameter (m)	Temp (K)	Exit Velocity (m/sec actual)	NO_X Mass Emission (g/s)
Lisheen Renewable	E1 Boiler	16.5	0.80	433.15	13.73	0.830
	E3 CHP gas engine	15	0.50	473.15	19.66	0.940

Installation	Emission Source	Stack Height Above Ground Level (m)	Stack Exit Diameter (m)	Temp (K)	Exit Velocity (m/sec actual)	NO_x Mass Emission (g/s)
Energy Limited	E4 CHP gas engine	15	0.50	473.15	19.66	0.940
	E5 Emergency flare	8	2.20	1323.15	5.00	0.330

Table 11.7 Summary of process emission information for the cumulative assessment.

11.4 Baseline Environment

11.4.1 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) (WHO, 2006). 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 Oak Park meteorological station, which is located approximately 53 km north-east of the site. Oak Park meteorological data has been examined to identify the prevailing wind direction and average wind speeds over a five-year period (see **Figure 11.1).** For data collated during five representative years (2019 – 2023), the predominant wind direction is westerly to south-westerly (Met Eireann, 2023).

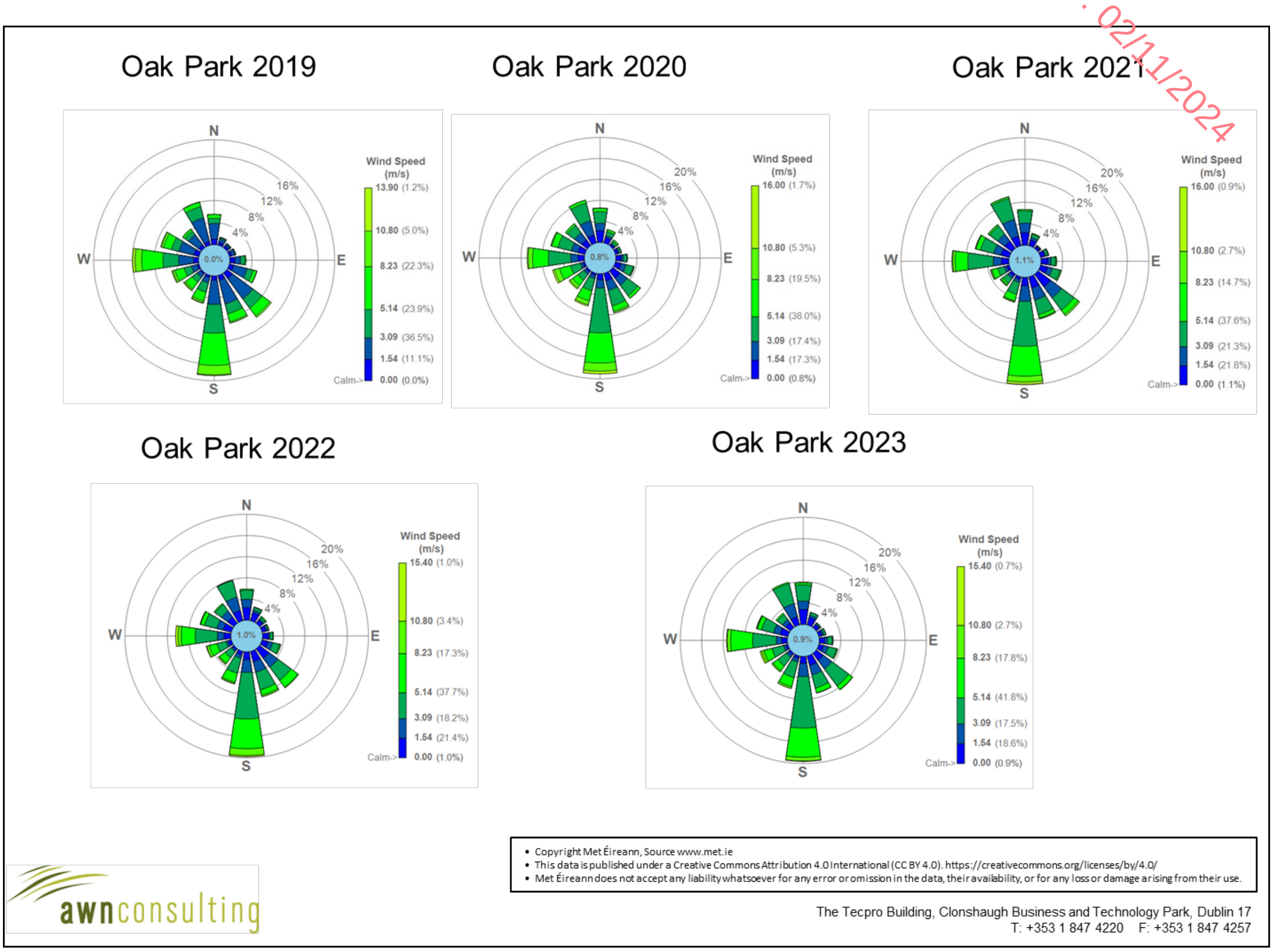

Figure 11.1: Oak Park Windrose 2019 – 2023. (Source: Met Eireann, 2023)

11.4.2 Air Quality Baseline

Air quality monitoring programs have been undertaken in recent years by the EPA. The most recent annual report on air quality in Ireland is *Air Quality In Ireland 2023* (EPA, 2024). 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, 2024).

As part of the implementation of the Framework Directive on Air Quality (1996/62/EC), as amended, four air quality zones have been defined in Ireland for air quality management and assessment purposes (EPA, 2024). Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 23 towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000, is defined as Zone D.

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

11.4.2.1 NO_2

Long-term NO_2 monitoring was carried out at the Zone D rural background locations of Emo Court and Kilkitt, which are considered representative of the area of the proposed development for the period 2019 – 2023 (EPA, 2024).

The NO_2 annual average in 2023 for both rural background locations of Emo Court and Kilkitt was 2 µg/m³ (see **Table 11.8**) . Therefore, long-term average concentrations measured at all locations were significantly lower than the annual average limit value of 40 µg/m³. Sufficient data is available to observe the long-term trend over the period 2019 – 2023, with annual average results ranging from 2 – 5 µg/m³ . A conservative estimate of the background NO_2 concentration for the region of the proposed development is therefore 5 µg/m³, as derived from these long-term trends.

Station	Averaging Period Note 1	Year				
		2019	2020	2021	2022	2023
Emo Court	Annual Mean NO_2 (µg/m³)	4	3	4	3	2
Kilkitt	Annual Mean NO_2 (µg/m³)	5	2	2	2	2

Table 11.8: Trends In Air Quality: Nitrogen Dioxide [NO_2]. (Source: EPA, 2024).

Note 1 Annual average limit value – 40 µg/m³ (EU Council Directive 2008/50/EC & S.I. No. 739 of 2022). Daily limit value – 200 µg/m³ (EU Council Directive 2008/50/EC & S.I. No. 739 of 2022).

In relation to the annual average background for NO_2, the ambient background concentration was added directly to the dispersion model process concentration with the short-term peaks assumed to have an ambient background concentration of twice the annual mean background concentration.

11.4.2.2 CO

In terms of CO, monitoring has been conducted at the suburban traffic Zone D site of Birr over the period 2020 – 2023. There are no other suitably representative CO monitoring stations within Zone D. Monitored concentrations are significantly below the ambient limit value of 10 mg/m³. Maximum 8-hour concentrations at the Birr site ranged from 1.2 mg/m³ – 3.4 mg/m³ over the period 2020 – 2023 (EPA, 2024).

Based on these results a background 8-hour CO concentration of 3.4 mg/m³ has been used in the modelling assessment. This estimated background concentration has been added directly to the modelled 8-hour maximum result to produce the predicted environmental concentration in terms of CO.

11.4.2.3 PM_{10}

Long-term PM_{10} monitoring was carried out at the Zone D rural background locations of Claremorris and Kilkitt which are considered representative of the area of the proposed development for the period 2019 – 2023 (EPA, 2024).

The PM_{10} annual average in 2023 for the rural background locations of Claremorris and Kilkitt ranged from 7 – 8 µg/m³. Therefore, long-term average concentrations measured at all locations were significantly lower than the annual average limit value of 40 µg/m³. In addition, there were at most 1 exceedances (in Kilkitt) of the 24-hour limit value of 50 µg/m³ in 2019, albeit 35 exceedances are permitted per year (EPA, 2024). Sufficient data is available observe the long-term trend over the period 2019 – 2023, with annual average results ranging from 7 – 11 µg/m³ (**Table 11.9**).

A conservative estimate of the background PM_{10} concentration, for the region of the proposed development is therefore 11 µg/m³, as derived from these long-term trends.

Station	Averaging Period Note 1	Year				
		2019	2020	2021	2022	2023
Claremorris	Annual Mean PM_{10} (µg/m³)	11	10	8	8	8
	90.4th%ile of 24-hr Means	20	16	13	13	-
Kilkitt	Annual Mean PM_{10} (µg/m³)	7	8	8	9	7
	90.4th%ile of 24-hr Means	13	14	13	14	-

Table 11.9: Trends In Zone D Air Quality: Particulate Matter (PM_{10}) (Source: EPA, 2023).

Note 1 Annual average limit value of 40 µg/m³ and 24 hour limit value of 50 µg/m³ not to be exceeded more than 35 times per year (EU Council Directive 2008/50/EC & S.I. No. 739 of 2022).

11.4.2.4 $PM_{2.5}$

Long-term $PM_{2.5}$ monitoring was carried out at the Zone D rural background locations of Claremorris and Shannon Estuary/Askeaton, Limerick which are considered representative of the area of the proposed development for the period 2019 – 2023 (EPA, 2024).

The $PM_{2.5}$ annual average in 2023 for the Zone D rural background locations of Claremorris and Shannon Estuary/Askeaton, Limerick ranged from 4.8 – 5.2 µg/m³. Therefore, long-term average concentrations measured at all locations were significantly lower than the annual average limit value of 25 µg/m³. Sufficient data is available to observe the long-term trend over the period 2019 – 2023, with annual average results ranging from 4 – 8 µg/m³ (**Table 11.10**).

A conservative estimate of the background $PM_{2.5}$ concentration, for the region of the proposed development is therefore 8 µg/m³, as derived from these long-term trends.

Station	Averaging Period Note 1	Year				
		2019	2020	2021	2022	2023
Claremorris	Annual Mean $PM_{2.5}$ (µg/m³)	4.0	5.1	8.2	6.1	5.2
Shannon Estuary/Askeaton, Limerick	Annual Mean $PM_{2.5}$ (µg/m³)	-	4.4	5.7	5.5	4.8

Table 11.10: Trends In Air Quality: Particulate Matter [$PM_{2.5}$]. (Source: EPA, 2024).

Note 1 Annual average limit value of 25 µg/m³ (EU Council Directive 2008/50/EC & S.I. No. 739 of 2022).

11.4.2.5 Sensitive Designated Habitats

Background concentrations for NO_X, and nitrogen and acid deposition at the most impacted modelled designated habitats (The Loughans Special Area of Conservation [SAC] and the Nore Valley Bogs Natural Heritage Area [NHA]) were derived from the 1 km grid square concentrations provided on the Air Pollution Information System (APIS) website (APIS, 2023), in line with UKEA (2014) and UK Defra (2022) guidance, and are shown in **Table 11.11**. The background concentrations are added directly to the modelled process contributions to give a total predicted environmental concentration.

Closest Sensitive Designated Habitat	NO_X (µg/m³)	Nitrogen Deposition (kg/ha/yr)	Acid Deposition (keq/ha/yr)
The Loughans SAC	2.8	6.8	0.5
Nore Valley Bogs NHA	2.8	7.3	0.5

Table 11.11: Background Concentrations for NO_X, SO_2, Nitrogen and Acid Deposition (Grid Average), (Source: APIS, 2023).

11.4.3 Sensitive Receptors

11.4.3.1 Construction Dust

In line with the UK Institute of Air Quality Management (IAQM) guidance document *Guidance on the Assessment of Dust from Demolition and Construction* (2024) prior to assessing the impact of dust from a proposed development, the sensitivity of the area must first be assessed as outlined below. Both receptor sensitivity and proximity to proposed works areas are taken into consideration. For the purposes of this assessment, high sensitivity receptors are regarded as residential properties where people are likely to spend the majority of their time. Commercial properties and places of work are regarded as medium sensitivity while low sensitivity receptors are places where people are present for short periods or do not expect a high level of amenity. Sensitive receptors are shown in **Figure 11.2**.

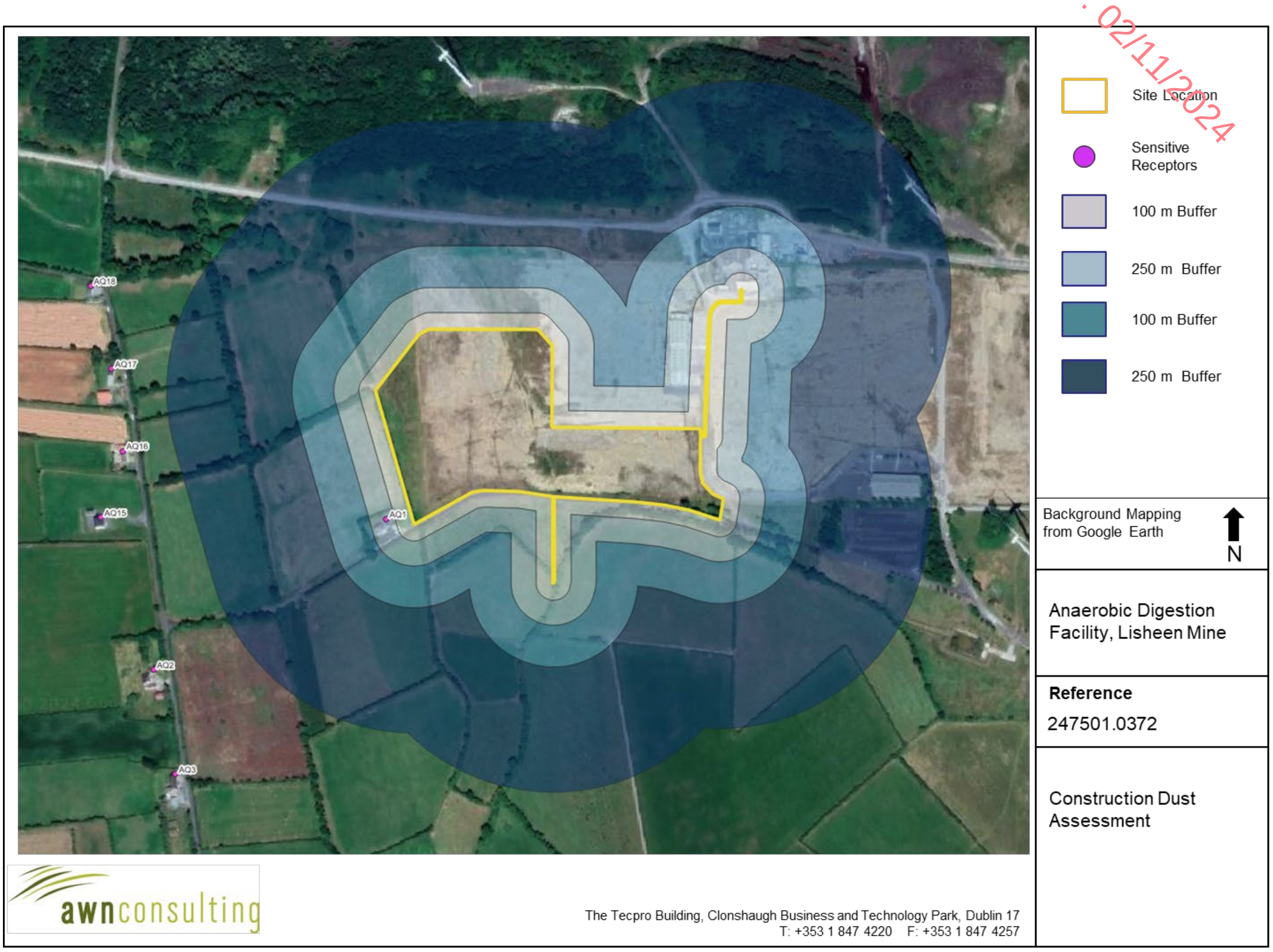

Figure 11.2: Construction Dust Receptors.

In terms of receptor sensitivity to dust soiling, there are between 1 and 10 high sensitivity residential properties with 250 m of the proposed main works areas. Based on the IAQM criteria outlined in **Table 11.12**, the worst-case sensitivity of the area to dust soiling is considered **low**.

Receptor Sensitivity	Number of Receptors	Distance from Source (metres) <20	<50	<100	<250
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table 11.12: Sensitivity of the Area to Dust Soiling Effects on People and Property. (Source: IAQM, 2024)

In addition to sensitivity to dust soiling, the IAQM guidelines also outline the assessment criteria for determining the sensitivity of the area to human health impacts. The criteria take into consideration the current annual mean

PM_{10} concentration, receptor sensitivity based on type (residential receptors are classified as high sensitivity) and the number of receptors affected within various distance bands from the construction works.

A conservative estimate of the current annual mean PM_{10} concentration in the vicinity of the proposed development is 16 µg/m^3. There are between 1 and 10 high sensitivity residential properties located within 250 metres of the proposed development site. Based on the IAQM criteria outlined in **Table 11.13**, the worst-case sensitivity of the area to human health is considered **low**.

Receptor Sensitivity	Annual Mean PM_{10} Concentration	Number of Receptors	Distance from Source (metres) <20	<50	<100	<200	<250
High	< 24 µg/m^3	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	< 24 µg/m^3	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	< 24 µg/m^3	>1	Low	Low	Low	Low	Low

Table 11.13: Sensitivity of the Area to Dust-Related Human Health Impacts. (Source: IAQM, 2024)

The IAQM guidelines also outline the assessment criteria for determining the sensitivity of the area to dust-related ecological effects. Dust emissions can coat vegetation leading to a reduction in the photosynthesising ability of the plant as well as other effects. The guidance states that dust impacts to vegetation can occur up to 50 metres from the site and 50 metres from site access roads, up to 500 metres for the site entrance. The sensitivity of the area is determined based on the distance to the source, the designation of the site, (European, National or local designation) and the potential dust sensitivity of the ecologically important species present. There are no designated habitat sites within 50 metres away from the proposed development which is the area of potential impact as per IAQM guidelines (IAQM, 2024). There is therefore no potential effects on ecology from construction dust due to the proposed development.

11.4.3.2 Air Dispersion Model

Modelled receptors included the proposed development boundary, gridded receptors and discrete sensitive receptors.

Three receptor grids were created at which concentrations would be modelled. Receptors were mapped with sufficient resolution to ensure all localised “hot-spots” were identified without adding unduly to processing time. The receptor grids were based on a Cartesian grid with the site at the centre. An outer grid measured 10 x 10 km with the site at the centre and with concentrations calculated at 200 metres intervals. A medium density grid measured 3 x 3 km with the site at the centre and with concentrations calculated at 100 metre intervals. A smaller, denser grid measured 1 x 1 km with concentrations calculated at 50 metre intervals. Boundary receptor locations were also placed along the boundary of the site, at 25 metre intervals.

The impact of the emission sources was also measured at nearby sensitive receptors (all residential) which were added to the model as discrete receptors see (**Table 11.14** and **Figure 11.3**).

All receptors were modelled at 1.5 m to represent breathing height.

Receptor	Co-Ordinates (UTM Zone 29 N)		Receptor	Co-Ordinates (UTM Zone 29 N)		Receptor	Co-Ordinates (UTM Zone 29 N)	
	X	Y		X	Y		X	Y
AQ1	588550	5845101	AQ9	588403	5844086	AQ17	588221	5845281
AQ2	588271	5844921	AQ10	588405	5844058	AQ18	588196	5845381
AQ3	588298	5844796	AQ11	588503	5843858	AQ19	587734	5845398
AQ4	588309	5844627	AQ12	588598	5843858	AQ20	591359	5845168
AQ5	588348	5844391	AQ13	588923	5844001	AQ21	591420	5845310
AQ6	588352	5844328	AQ14	589427	5844128	AQ22	590495	5845941
AQ7	588461	5844204	AQ15	588209	5845103	AQ23	590208	5846376
AQ8	588399	5844108	AQ16	588235	5845183			

Table 11.14: Modelled Discrete Sensitive Receptors.

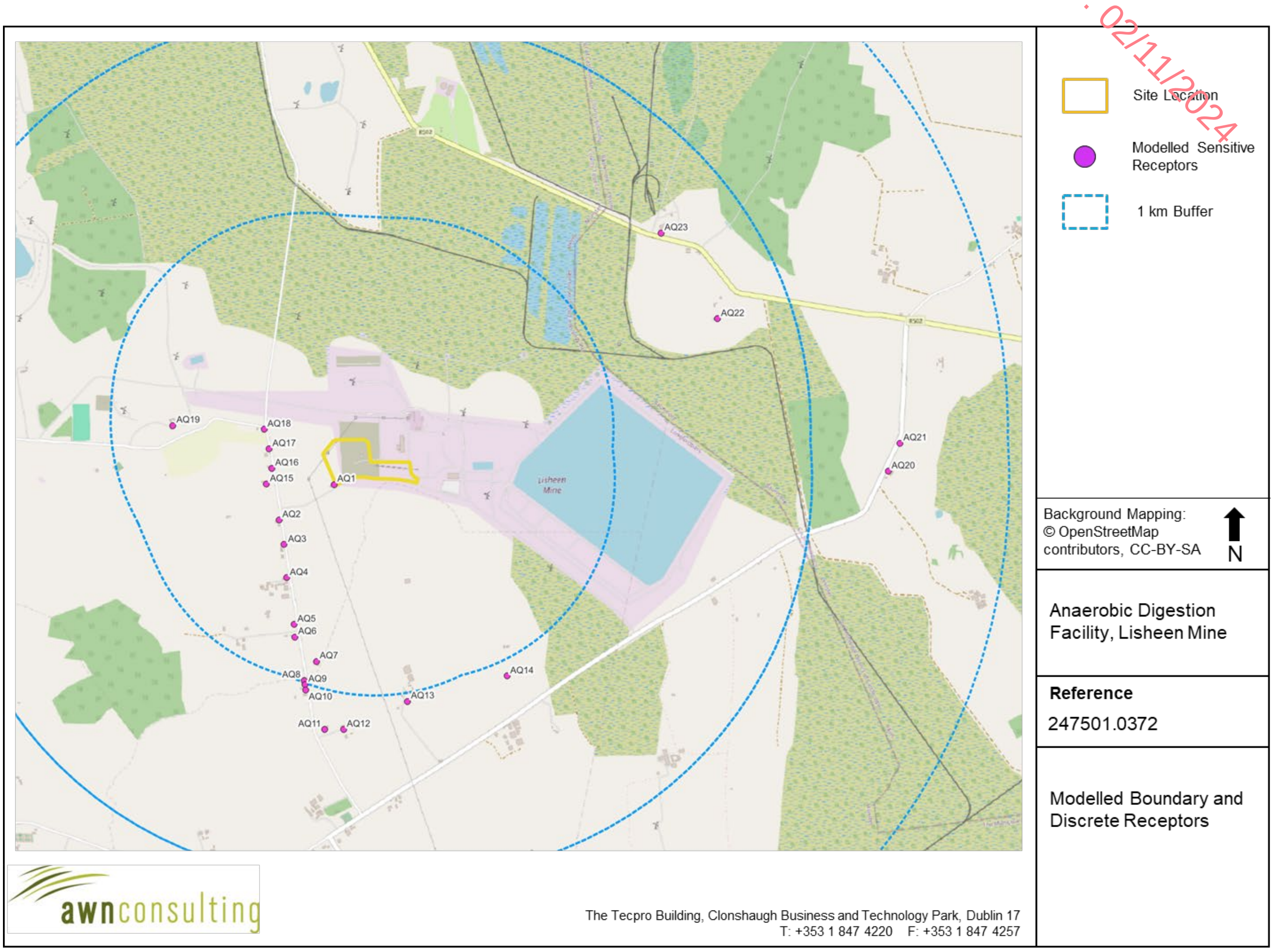

Figure 11.3: Modelled Boundary and Discrete Receptors.

The following designated habitats within 20 km of the facility were modelled (at 0 m height) to determine the impact of emissions of NO_X and nitrogen and acid deposition (as N) on ambient ground level concentrations within the sites:

- **Natural Heritage Areas [NHA]** – Nore Valley Bogs NHA;
- **Proposed Natural Heritage Areas [pNHA]** – Aghsmear House pNHA, Cabragh Wetlands pNHA, Coolacurragh Wood pNHA, Cuffsborough pNHA, Cullahill Mountain pNHA, Galmoy Fen pNHA, Grantstown Wood And Lough pNHA, Kilcooly Abbey Lake pNHA, Kilduff, Devilsbit Mountain pNHA, Killough Hill pNHA, Laffansbridge pNHA, Ormond's Mill, Loughmoe, Templemore pNHA, Spahill And Clomantagh Hill pNHA, Templemore Wood pNHA, The Curragh And Goul River Marsh pNHA, The Loughans pNHA;
- **Special Areas of Conservation [SAC]** – Lower River Suir SAC, River Barrow And River Nore SAC, The Loughans SAC, Galmoy Fen SAC, Cullahill Mountain SAC, Kilduff, Devilsbit Mountain SAC, Spahill and Clomantagh Hill SAC;
- **Special Protection Area [SPA]** – River Nore SPA.

The closest designated habitat to the facility is The Loughans SAC, which is approx. 10 km to the south-east of the proposed development.

11.5 Potential Impacts of the Proposed Development

11.5.1 Do Nothing

Under the Do Nothing Scenario the proposed development will not be constructed, no construction works associated with the proposed development will take place and the previously identified impacts of fugitive dust and particulate matter emissions and emissions from equipment and machinery will not occur. The operational emissions to air associated with the proposed development will also not occur. However, as the site is zoned for development, in the absence of the proposed development it is likely that a development of a similar nature would be constructed in the future in line with national policy and the development plan objectives. Therefore, the construction and operational phase impacts outlined in this assessment may occur in the future even in the absence of the proposed development.

11.5.2 Construction Phase

11.5.2.1 Construction Dust Assessment

The greatest potential effect on air quality during the construction phase of the proposed development is from construction dust emissions and the potential for nuisance dust. While construction dust tends to be deposited within 250 metres of a construction site, the majority of the deposition occurs within the first 50 metres. The extent of any dust generation depends on the nature of the dust (soils, peat, sands, gravels, silts etc.) and the nature of the construction activity. In addition, the potential for dust dispersion and deposition depends on local meteorological factors such as rainfall, wind speed and wind direction. A review of Oak Park meteorological data indicates that the prevailing wind direction is westerly to south-westerly and wind speeds are generally moderate in nature (see **Figure 11.1**). In addition, dust generation is considered negligible on days where rainfall is greater than 0.2 mm. A review of historical 30 year average data for Shannon Airport meteorological station (site closest to Proposed Development with 30 year average data available) indicates that, on average, 223 days per year have rainfall over 0.2 mm (Met Eireann, 2023). Therefore, it can be determined that over 61% of the time dust generation will be reduced due to natural meteorological conditions.

In order to determine the level of dust mitigation required during the proposed works, the potential dust emission magnitude for each dust generating activity needs to be taken into account, in conjunction with the previously established sensitivity of the area (see **Section 11.4.3.1**).

Demolition

There are no demolition activities associated with the Proposed Development. Therefore, there is no potential for air quality impacts from demolition.

Earthworks

Earthworks primarily involve excavating material, loading and unloading of materials, tipping and stockpiling activities. Activities such as levelling the site and landscaping works are also considered under this category. The dust emission magnitude from earthworks can be classified as small, medium or large based on the definitions from the IAQM guidance as transcribed below:

- **Large**: Total site area > 110,000 m^2, potentially dusty soil type (e.g., clay which will be prone to suspension when dry due to small particle size), > 10 heavy earth moving vehicles active at any one time, formation of bunds >6 metres in height;
- **Medium**: Total site area 18,000 m^2 – 110,000 m^2, moderately dusty soil type (e.g., silt), 5 - 10 heavy earth moving vehicles active at any one time, formation of bunds 3 – 6 metres in height;
- **Small**: Total site area < 18,000 m^2, soil type with large grain size (e.g., sand), < 5 heavy earth moving vehicles active at any one time, formation of bunds < 3 metres in height.

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

Table 11.15: Criteria for Rating Risk of Dust Impacts: Earthworks. (Source: IAQM, 2024)

The total site area is between 18,000 m^2 and 110,000 m^2. Therefore, the proposed earthworks can be classified as **medium**. The sensitivity of the area, as determined in **Section 11.4.3.1**, is combined with the dust emission magnitude for each dust generating activity to define the risk of dust impacts in the absence of mitigation. As outlined in **Table 11.15** and **Table 11.16**, this results in this results in a low risk of dust soiling and low risk of human health impacts.

Receptor	Receptor Sensitivity	Dust Emission Magnitude – Earthworks	Risk of Dust-Related Impacts
Dust Soiling	Low	Medium	Low Risk
Human Health	Low		Low Risk

Table 11.16: Risk of Dust Impacts: Earthworks

Construction

Dust emission magnitude from construction can be classified as small, medium or large based on the definitions from the IAQM guidance as transcribed below:

- **Large**: Total building volume > 750,000 m^3, on-site concrete batching, sandblasting;

- **Medium**: Total building volume 12,000 m³ – 75,000 m³, potentially dusty construction material (e.g., concrete), on-site concrete batching;
- **Small**: Total building volume < 12,000 m³, construction material with low potential for dust release (e.g., metal cladding or timber).

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

Table 11.17: Criteria for Rating Risk of Dust Impacts: Construction. (Source: IAQM, 2024)

The dust emission magnitude for the proposed construction activities can be classified as **medium** as a worst-case, as the total building volume constructed will be between 12,000 m³ and 75,000 m³. The sensitivity of the area, as determined in **Section 11.4.3.1**, is combined with the dust emission magnitude for each dust generating activity to define the risk of dust impacts in the absence of mitigation. As outlined in **Table 11.17** and **Table 11.18**, this results in a low risk of dust soiling and low risk of human health impacts.

Receptor	Receptor Sensitivity	Dust Emission Magnitude – Construction	Risk of Dust-Related Impacts
Dust Soiling	Low	Medium	Low Risk
Human Health	Low		Low Risk

Table 11.18: Risk of Dust Impacts: Construction

Trackout

Factors which determine the dust emission magnitude are vehicle size, vehicle speed, number of vehicles, road surface material and duration of movement. Dust emission magnitude from trackout can be classified as **small**, medium or large based on the definitions from the IAQM guidance as transcribed below:

- **Large**: > 50 HDV (> 3.5 t) outward movements in any one day, potentially dusty surface material (e.g., high clay content), unpaved road length > 100 m;
- **Medium**: 20 - 50 HDV (> 3.5 t) outward movements in any one day, moderately dusty surface material (e.g., high clay content), unpaved road length 50 – 100 m;
- **Small**: < 20 HDV (> 3.5 t) outward movements in any one day, surface material with low potential for dust release, unpaved road length < 50 m.

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

Low	Low Risk	Low Risk	Negligible

Table 11.19: Criteria for Rating Risk of Dust Impacts: Trackout. (Source: IAQM, 2024)

The dust emission magnitude for the proposed trackout can be conservatively classified as **small** as, at worst-case periods, there will likely be less than 20 outward HDV movements per day. The sensitivity of the area, as determined in **Section 11.4.3.1**, is combined with the dust emission magnitude for each dust generating activity to define the risk of dust impacts in the absence of mitigation. As outlined in **Table 11.19** and **Table 11.20**, this results in this results in a negligible risk of dust soiling and negligible risk of human health impacts.

Receptor	Receptor Sensitivity	Dust Emission Magnitude – Trackout	Risk of Dust-Related Impacts
Dust Soiling	Low	Small	Negligible Risk
Human Health	Low		Negligible Risk

Table 11.20: Risk of Dust Impacts: Trackout

Summary of Dust Emission Risk

The risk of dust effects as a result of the proposed development are summarised in **Table 11.21** for each activity. The magnitude of risk determined is used to prescribe the level of site-specific mitigation required for each activity to prevent significant impacts occurring.

Overall, to ensure that no dust nuisance occurs during the earthworks, construction and trackout activities, best practice dust mitigation measures appropriate for sites with a low risk of dust impacts must be implemented. In the absence of mitigation dust impacts are predicted to be ***direct***, ***short-term, localised, negative*** and ***slight***.

Potential Impact	Demolition	Earthworks	Construction	Trackout
Dust Emission Magnitude	N/A	Medium	Medium	Small
Dust Soiling Risk	N/A	Low Risk	Low Risk	Negligible Risk
Human Health Risk	N/A	Low Risk	Low Risk	Negligible Risk
Ecology Risk	N/A	N/A	N/A	N/A

Table 11.21: Summary of Dust Impact Risk used to Define Site-Specific Mitigation.

11.5.2.1 Construction Traffic Assessment

There is also the potential for traffic emissions to impact air quality in the short-term over the construction phase, particularly due to the increase in HGVs accessing the site. The construction stage traffic has been reviewed and a detailed air quality assessment has been scoped out as none of the road links affected by the proposed development satisfy the TII assessment criteria in **Section 11.3.1.2**.

It can therefore be determined that the construction stage traffic will have a ***direct***, ***short-term, negative*** and ***imperceptible*** effect on air quality.

11.5.2 Operational Phase

11.5.2.1 Operational Traffic Assessment

There is also the potential for traffic emissions to impact air quality in the long-term over the operational phase, particularly due to the increase in vehicles accessing the site. The operational stage traffic has been reviewed and a detailed air quality assessment has been scoped out as none of the road links affected by the proposed development satisfy the TII assessment criteria in **Section 11.3.2.1**.

It can therefore be determined that the operational stage traffic will have a ***direct***, ***long-term, negative*** and ***imperceptible*** effect on air quality.

11.5.2.1 Air Dispersion Modelling

NO_2

The NO_2 modelling results at the worst-case receptor (at the site boundary) are detailed in **Table 11.22**. The results indicate that the ambient ground level concentrations are in compliance with the relevant air quality standards for NO_2. For the worst-case year, emissions from the site lead to an ambient NO_2 concentration (including background) which is 47% of the maximum ambient 1-hour limit value (measured as a 99.8^{th} percentile) and 26% of the annual limit value at the worst-case receptor (at the site boundary). The locations of the maximum concentrations for NO_2 are close to the boundary of the site with concentrations decreasing with distance from the facility.

The geographical variations in ground level NO_2 concentrations beyond the facility boundary for the worst-case years modelled are illustrated as predicted environmental concentration [PEC] contours in **Figure 11.4** and **Figure 11.5**, to demonstrate the direction and extent of the emission plume.

In summary, emissions to atmosphere of NO_2 from the site will be in compliance with the ambient air quality standards which are based on the protection of the environment and human health. Therefore, the effect of the proposed development in terms of NO_2 can be considered ***direct***, ***negative, long-term*** and ***slight***, which is overall not significant in EIA terms.

Pollutant/ Year	Averaging Period	Process Contribution (µg/m^3)	Background (µg/m^3)	Predicted Emission Concentration (µg/m^3)	Standard (µg/m^3) Note 1	PEC as a % of Limit Value
NO_2/2019	Annual mean	4.8	5	9.8	40	25%
	99.8^{th}%ile of 1-hr means	83.1	10	93.1	200	47%
NO_2/2020	Annual mean	5.5	5	10.5	40	26%
	99.8^{th}%ile of 1-hr means	83.3	10	93.3	200	47%

Pollutant/ Year	Averaging Period	Process Contribution (µg/m³)	Background (µg/m³)	Predicted Emission Concentration (µg/m³)	Standard (µg/m³) Note 1	PEC as a % of Limit Value
NO_2/2021	Annual mean	4.0	5	9.0	40	22%
	99.8th%ile of 1-hr means	82.5	10	92.5	200	46%
NO_2/2022	Annual mean	4.7	5	9.7	40	24%
	99.8th%ile of 1-hr means	84.2	10	94.2	200	47%
NO_2/2023	Annual mean	4.9	5	9.9	40	25%
	99.8th%ile of 1-hr means	82.8	10	92.8	200	46%

Table 11.22: Proposed Operations - Dispersion Model Results for Nitrogen Dioxide [NO_2].

Note 1 Air Quality Standards 2022 (from EU Directive 2008/50/EC and S.I. 739 of 2022).

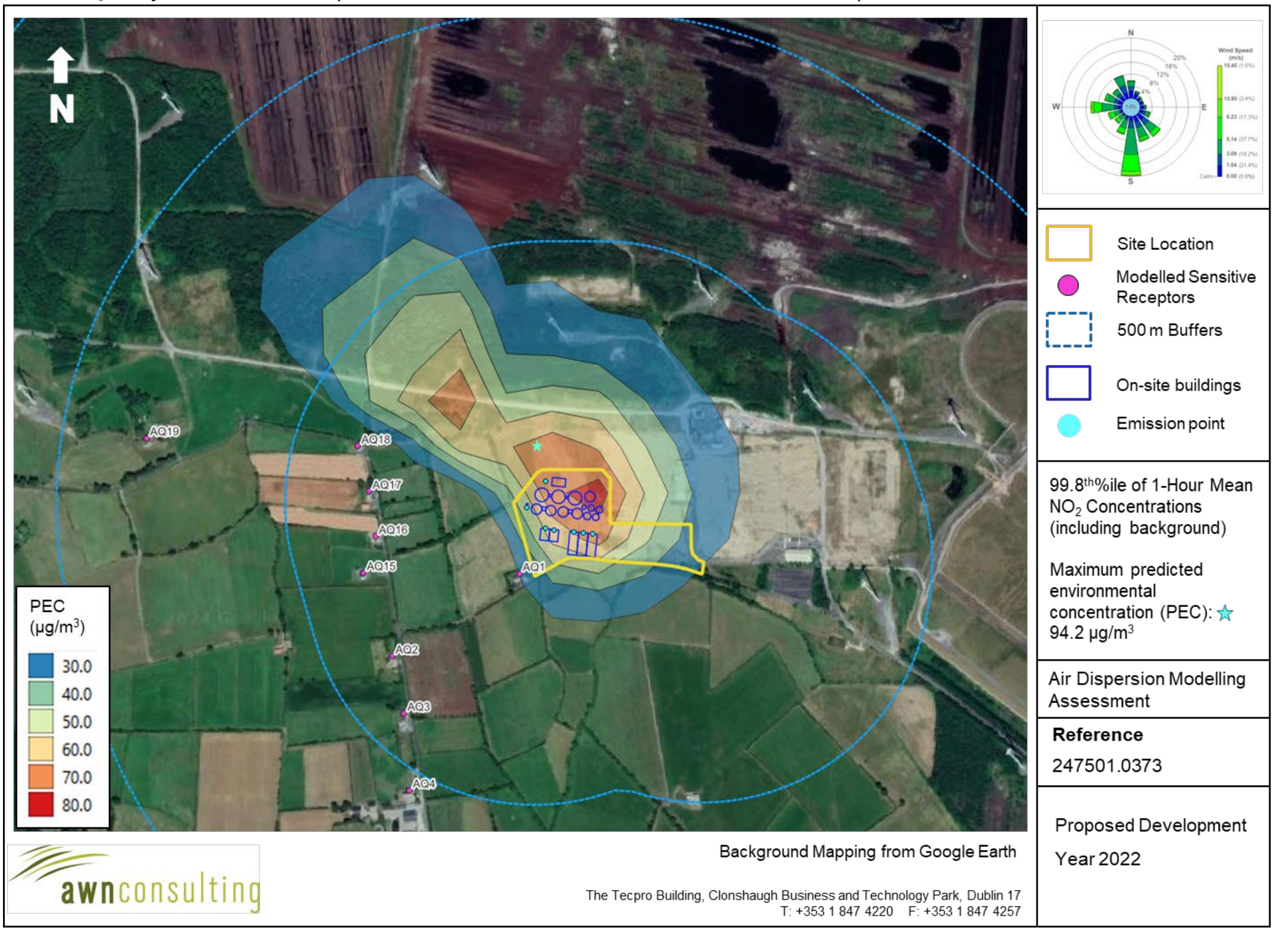

Figure 11.4: Proposed Operations - Maximum 1-Hour NO_2 Concentrations (as 99.8th%ile) (µg/m³).

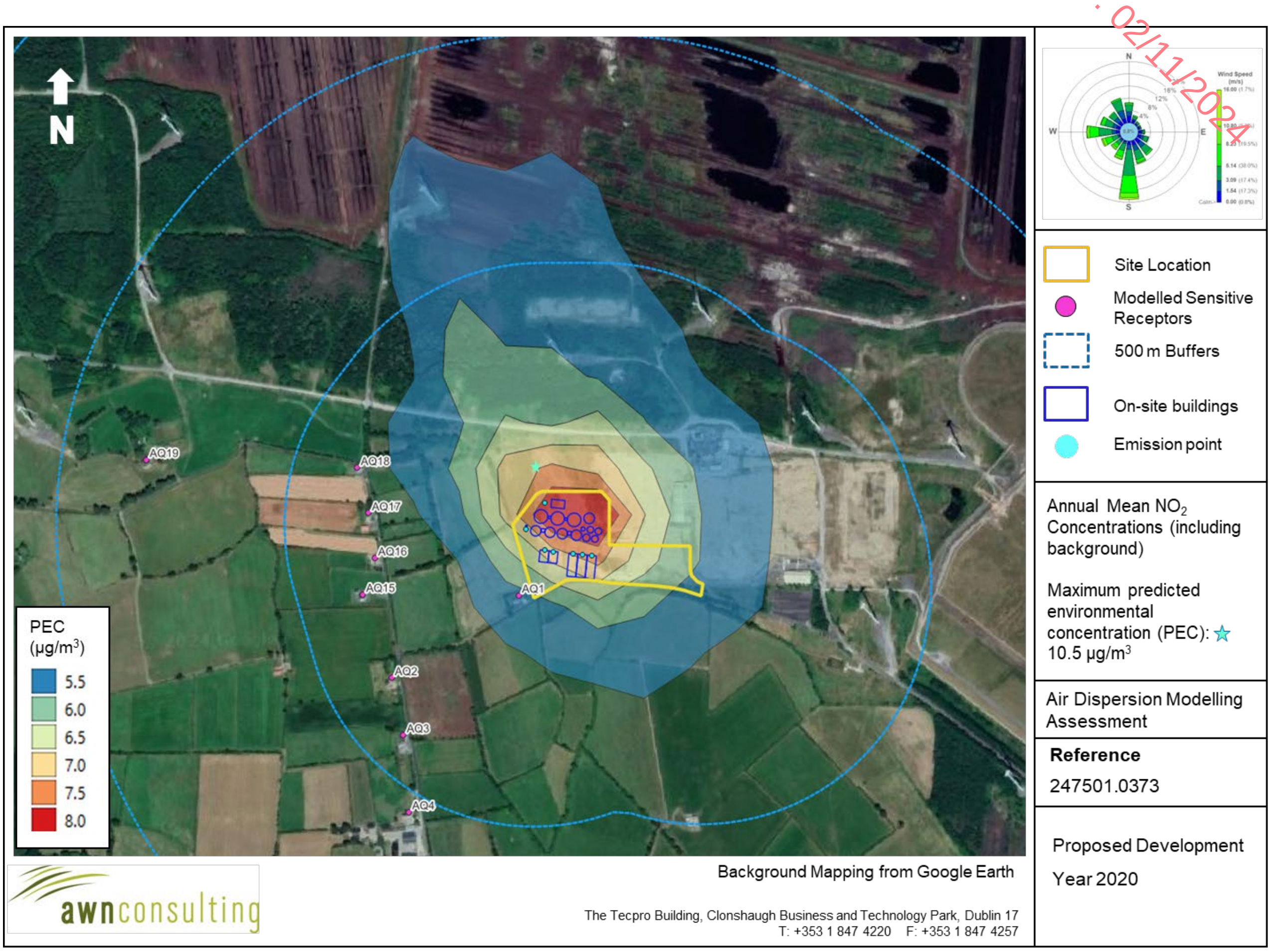

Figure 11.5: Proposed Operations - Annual Mean NO_2 Concentrations (µg/m³).

Impact on Designated Habitat Sites

The ecological habitat site most impacted by the facility, where the highest modelled concentrations are predicted, is The Loughans SAC.

The NO_X modelling results are detailed in **Table 11.23**. Emissions from the facility lead to an ambient NO_X concentration (including background) which is at most 9% of the annual limit value the worst-case location within the designated sites over the five years of meteorological data modelled. The effects of NO_X on designated sites due to the proposed operations of the facility are ***direct, long-term, negative*** and ***not significant***, which is overall not significant in EIA terms.

Pollutant/ Year	Averaging Period	Process Contribution (PC) NO_X (µg/m³)	Background (µg/m³)	Predicted Emission Concentration (PEC) NO_X (µg/m³)	Limit Value (µg/m³)	PEC as a % of Limit Value
NO_X/2019	Annual mean	0.04	2.8	2.84	30	9%

Pollutant/ Year	Averaging Period	Process Contribution (PC) NO_X (µg/m³)	Background (µg/m³)	Predicted Emission Concentration (PEC) NO_X (µg/m³)	Limit Value (µg/m³)	PEC as a % of Limit Value
NO_X/2020	Annual mean	0.04	2.8	2.84	30	9%
NO_X/2021	Annual mean	0.04	2.8	2.84	30	9%
NO_X/2022	Annual mean	0.03	2.8	2.83	30	9%
NO_X/2023	Annual mean	0.04	2.8	2.84	30	9%

Table 11.23: Proposed Operations - NO_X Designated Habitat Dispersion Model Results.

In order to consider the effects of nitrogen and acid deposition (as N) owing to emissions from the facility on the designated habitat sites, the maximum annual mean NO_2 predicted environmental concentrations are converted into the dry deposition fluxes and then nitrogen and acid deposition (as N) fluxes (as described in **Section 11.3.2.2 Designated Habitat Sites**) and shown in **Table 11.4**.

No comparable habitat with established critical load estimate is available from APIS (APIS, 2023) for The Loughans SAC. Therefore the second most impacted designated habitat site, Nore Valley Bogs NHA, has been considered instead.

The nitrogen deposition flux for the worst-case year is 6.805 kg/ha/yr, shown in **Table 11.24**, and is within the range in worst-case critical loads of 5-10 kg/ha/yr (APIS, 2023) for the habitat type "Raised and blanket bogs" in the Nore Valley Bogs NHA, indicating that the effects of nitrogen deposition on designated sites due to the proposed operations of the facility are ***direct, long-term, negative*** and ***not significant***, which is overall not significant in EIA terms.

Year	NO_2 Annual Mean PC (µg/m3)	Dry Deposition Flux (µg/m²/s)	PC Nitrogen Deposition Flux (kg/ha/year)	APIS Background Nitrogen Deposition (kg/ha/yr)	PEC Nitrogen Deposition kg/ha/yr
2019	0.03	0.00004	0.004	6.8	6.804
2020	0.03	0.00004	0.004	6.8	6.804
2021	0.03	0.00005	0.005	6.8	6.805
2022	0.02	0.00004	0.003	6.8	6.803
2023	0.03	0.00005	0.004	6.8	6.804

Table 11.24: Proposed Operations - Nitrogen Deposition Designated Habitat Dispersion Model Results.

The acid deposition (as N) flux for the worst-case year is 0.500 keq/ha/yr, shown in **Table 11.25**, and is within the worst case maximum critical load range of 0.286 – 5.057 keq/ha/yr for the habitat "Raised and blanket bogs" in the Nore Valley Bogs NHA (APIS, 2023), indicating that the effects of acid deposition (as N) on designated sites due to the proposed operations of the facility are ***direct, long-term, negative*** and ***not significant***, which is overall not significant in EIA terms.

Year	NO_2 Annual Mean PC (µg/m[3])	Dry Deposition Flux (µg/m[2]/s)	PC Acid Deposition keq/ha/yr	APIS Background Acid Deposition (keq/ha/yr)	PEC Acid Deposition (as N) keq/ha/yr)
2019	0.03	0.00004	0.0003	0.5	0.500
2020	0.03	0.00004	0.0003	0.5	0.500
2021	0.03	0.00005	0.0004	0.5	0.500
2022	0.02	0.00004	0.0002	0.5	0.500
2023	0.03	0.00005	0.0003	0.5	0.500

Table 11.25: Proposed Operations - Acid Deposition Designated Habitat Dispersion Model Results.

CO

The CO modelling results at the worst-case receptor (considers boundary, gridded and sensitive receptors) are detailed in **Table 11.26**. The results indicate that the ambient ground level concentrations are in compliance with the relevant air quality standards for CO. Emissions from the facility lead to an ambient CO concentration (including background) which is at most 36% of the maximum 8-hour limit value at the worst-case receptor. The locations of the maximum concentrations for CO are close to the boundary of the site with concentrations decreasing with distance from the facility.

The geographical variations in ground level CO predicted environmental concentration (PEC) concentrations beyond the facility boundary for the worst-case year modelled are illustrated as concentration contours in **Figure 11.6**, to demonstrate the direction and extent of the emission plume.

In summary, emissions to atmosphere of CO from the site will be in compliance with the ambient air quality standards which are based on the protection of the environment and human health. The effect of proposed operations SO_2 emissions on air quality is considered ***direct, long-term, negative*** and ***not significant***, which is overall ***not significant*** in EIA terms.

Pollutant/ Year	Averaging Period	Process Contribution (mg/m[3])	Background (mg/m[3])	Predicted Emission Concentration (mg/m[3])	Standard (mg/m[3]) Note 1	PEC as a % of Limit Value
CO/2019	Maximum Daily 8-Hour Mean	0.17	3.4	3.57	10	36%
CO/2020	Maximum Daily 8-Hour Mean	0.19	3.4	3.59	10	36%
CO/2021	Maximum Daily 8-Hour Mean	0.20	3.4	3.60	10	36%
CO/2022	Maximum Daily 8-Hour Mean	0.18	3.4	3.58	10	36%
CO/2023	Maximum Daily 8-Hour Mean	0.17	3.4	3.57	10	36%

Table 11.26: Proposed Operations - Dispersion Model Results for Carbon Monoxide [CO].

Note 1 Air Quality Standards 2022 (from EU Directive 2008/50/EC and S.I. 739 of 2022).

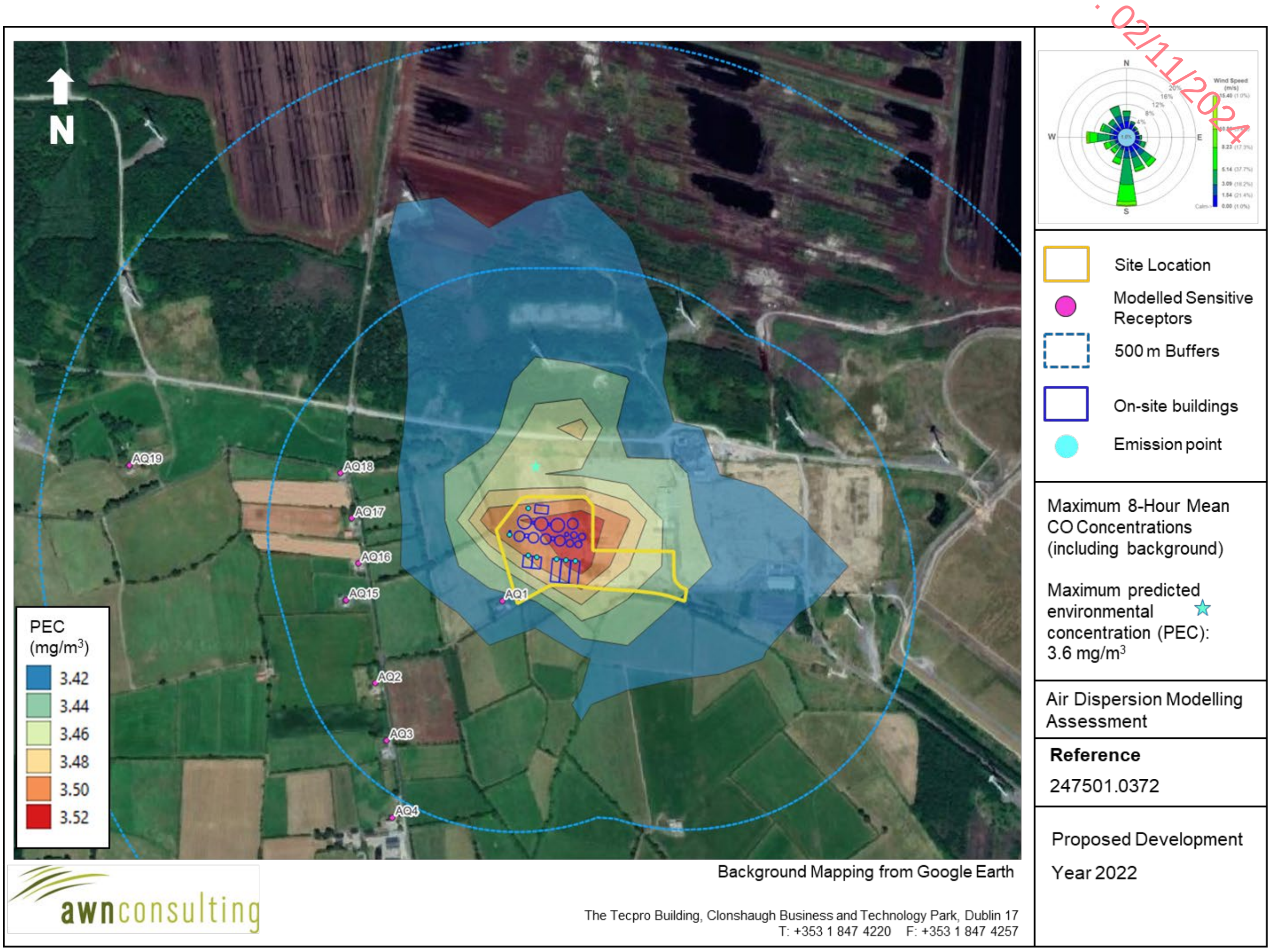

Figure 11.6: Proposed Operations - Maximum 8-Hour CO Concentrations (mg/m^3).

Odour

The predicted odour concentration is the maximum concentration predicted at the nearest odour sensitive residential receptor.

The odour modelling results with the proposed development in place are detailed in **Table 11.27**. The results indicate that the predicted ground level concentrations are below the relevant odour guideline value of 1.5 OU_E/m^3. Under worst-case operation of the Proposed Development, the 98th%ile of mean hourly odour concentrations ranges from 0.18 – 0.40 OU_E/m^3 at the worst-case sensitive receptor. For the worst-case year, emissions from the site lead to predicted ambient hourly mean (measured as a 98th percentile) odour concentrations which are at most 27% of the of the relevant odour criterion at the worst-case receptor (location shown in **Figure 11.8**).

Therefore, the effect of the proposed development in terms of odour can be considered ***direct***, ***negative, long-term*** and ***slight***, which is overall not significant in EIA terms.

The geographical variations in ambient ground level odour concentrations beyond the facility boundary for the worst-case year modelled are illustrated as concentration contours in Figure 4, to demonstrate the direction and extent of the emission plume.

Pollutant/ Year	Averaging Period	Process Contribution (µg/m^3)	Predicted Emission Concentration (µg/m^3)	Guideline Value (OU_E/m^3)	PEC as a % of Guideline Value
Odour/2019	Maximum 1-Hour (as a 98th%ile)	0.002	0.002	1.5	0.1%
Odour/2020	Maximum 1-Hour (as a 98th%ile)	0.002	0.002	1.5	0.1%
Odour/2021	Maximum 1-Hour (as a 98th%ile)	0.002	0.002	1.5	0.1%
Odour/2022	Maximum 1-Hour (as a 98th%ile)	0.003	0.003	1.5	0.2%
Odour/2023	Maximum 1-Hour (as a 98th%ile)	0.003	0.003	1.5	0.2%

Table 11.27: Proposed Operations - Dispersion Model Results for Odour.

Note 1 PEC is the Predicted Emission Concentration which includes the predicted contribution from the proposed development as well as the background concentration. As there is no relevant background level for odour, the PEC is the same as the Process Contribution.

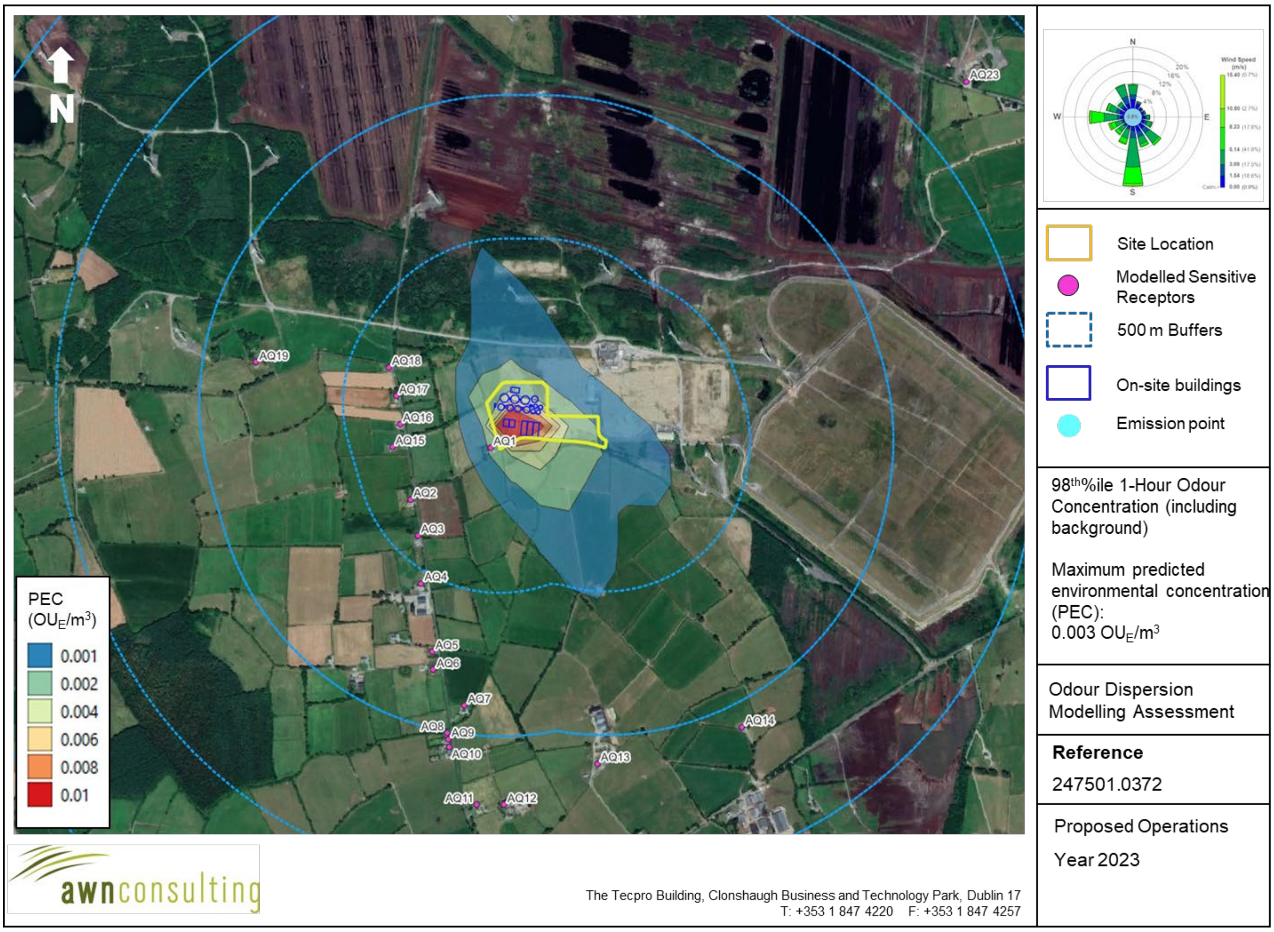

Figure 11.8: Proposed Operations - Maximum 1-Hour Odour Concentrations (as 98th%ile) (OU_E/m^3).

11.6 Mitigation Measures

11.6.1 Construction Phase

The proposed development has been assessed as having a low risk of dust soiling impacts and a low risk of dust related human health impacts during the construction phase as a result of earthworks, construction and trackout activities (see Section 6.3.1.1). Therefore, the following dust mitigation measures shall be implemented during the construction phase of the proposed development. These measures are appropriate for sites with a low risk of dust impacts and aim to ensure that no significant nuisance occurs at nearby sensitive receptors. The mitigation measures draw on best practice guidance from Ireland (DCC, 2018), the UK (IAQM (2024), BRE (2003), The Scottish Office (1996), UK ODPM (2002)) and the USA (USEPA, 1997). These measures will be incorporated into the overall Construction Environmental Management Plan (CEMP) prepared for the site. The measures are divided into different categories for different activities.

Communications

- Develop and implement a stakeholder communications plan that includes community engagement before works commence on site. Community engagement includes explaining the nature and duration of the works to local residents and businesses.
- The name and contact details of a person to contact regarding air quality and dust issues shall be displayed on the site boundary, this notice board should also include head/regional office contact details.

Site Management

- During working hours, dust control methods will be monitored as appropriate, depending on the prevailing meteorological conditions. Dry and windy conditions are favourable to dust suspension therefore mitigations must be implemented if undertaking dust generating activities during these weather conditions.
- A complaints register will be kept on site detailing all telephone calls and letters of complaint received in connection with dust nuisance or air quality concerns, together with details of any remedial actions carried out.

Preparing and Maintaining the Site

- Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.
- Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.
- Avoid site runoff of water or mud.
- Keep site fencing, barriers and scaffolding clean using wet methods.

- Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below.
- Cover, seed or fence stockpiles to prevent wind whipping.

Operating Vehicles/Machinery and Sustainable Travel

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

Operations

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

Waste Management

- Avoid bonfires and burning of waste materials.

Measures Specific to Earthworks

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

Measures Specific to Construction

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

Measures Specific to Trackout

- A speed restriction of 15 kph will be applied as an effective control measure for dust for on-site vehicles.
- Avoid dry sweeping of large areas.
- Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
- Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.
- Record all inspections of haul routes and any subsequent action in a site log book.
- Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.
- Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).
- Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.
- Access gates to be located at least 10 m from receptors where possible.

Monitoring

- Undertake daily on-site and off-site inspections, where receptors (including roads) are nearby, to monitor dust, record inspection results in the site inspection log. This should include regular dust soiling checks of surfaces such as street furniture, cars and windowsills within 100 m of site boundary, with cleaning to be provided if necessary.
- Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.

11.6.2 Operational Phase

An Odour Treatment System designed to manage odours from biogas and organic waste facilities has been incorporated into the design of the Proposed Development. Potential odour impacts from the various digestor tanks and biofertilizer processing plant and storage will be mitigated by this system.
The following odour mitigation measures will be adopted for the management of the proposed development:

- Whole crop feedstocks will be stored in concrete-walled and floored clamps, where they are compacted and covered with a plastic tarp to create an airtight seal.
- Equine, farmyard, and broiler manure will be housed in storage sheds specifically designed to manage moisture levels and odour control prior to processing.
- Liquid feedstocks will be pumped into a dedicated liquid feedstock tank, which will minimise fugitive odour emissions.
- Vehicles exiting the site will be subjected to cleaning procedures in accordance with the DAFM Conditions Document in a designated cleaning area.
- Deliveries of feedstock will be in enclosed trailers and sealed vacuum tankers.
- Feedstock delivery times will be controlled in order to minimise truck weighting times and therefore minimising fugitive odour emissions on-site.
- Digestate will be dewatered and pasteurised before removal from the site in order to minimise odour generation.
- An odour management plan will be prepared for the operational phase of the site to ensure that all odour control methods applied are sufficient and assessed at regular intervals. The plan will also outline a procedure for addressing any odour complaints.

The stack heights of the CHP generator and the emergency flare are of an adequate height to aid dispersion of the emissions and achieve compliance with the air quality standards at all off-site locations.

There is no further mitigation required for the operational phase of the development as effects on air quality are predicted to be ***direct, long-term, negative*** and ***not significant***, which is overall not significant in EIA terms.

11.6.3 Monitoring Measures

Monitoring requirements for the Proposed Development will be described in the Environmental Monitoring Plan submitted alongside the EIAR and further developed and agreed with stakeholders prior to construction. Monitoring in the form of visual inspections for nuisance dust has been outlined in **Section 11.6.1**.

The assessment of impacts on air quality as a result of the construction and operation the proposed development are predicted to be not significant in EIA terms. Based on the predicted impacts it is concluded that no additional monitoring is required.

11.7 Residual Impacts

11.7.1 Construction Phase

Once the dust minimisation measures outlined in **Section 11.6.1** are implemented, the effect of the proposed development in terms of dust soiling and human health will be ***direct, short-term, localised, negative*** and ***not significant*** at the assessed nearby receptor, which is overall not significant in EIA terms.

11.7.2 Operational Phase

A detailed air quality assessment of the operational stage traffic has been scoped out and it can therefore be determined that the operational stage traffic will have a ***direct***, ***long-term, negative*** and ***imperceptible*** effect on air quality, which is overall not significant in EIA terms.

Emissions of air pollutants during the operational phase are predicted to be significantly below the ambient air quality standards, which are based on the protection of human health. Therefore, residual effects on human health related to air quality will be ***direct, long-term, negative*** and ***not significant***, which is overall not significant in EIA terms.

11.7.3 Risk to Human Health

Dust emissions from the construction phase of the proposed development have the potential to affect human health through the release of PM_{10} and $PM_{2.5}$ emissions. As per **Section 11.4.3.1**, the surrounding area is of low sensitivity to dust related human health impacts. It was determined that there is an overall low risk of dust related human health effects as a result of the construction phase of the proposed development.

Best practice mitigation measures are proposed for the construction phase of the proposed development which will focus on the pro-active control of dust and other air pollutants to minimise generation of emissions at source. The mitigation measures that will be put in place during construction of the proposed development will ensure that the impact of the development complies with all EU ambient air quality legislative limit values which are based on the protection of human health. Therefore, the effect of construction of the proposed development is likely to be ***direct, short-term, localised, negative*** and ***not significant*** with respect to human health, which is overall not significant in EIA terms.

Traffic related air emissions have the potential to affect air quality which can affect human health. As the construction and operational phase traffic have been scoped out of a detailed air quality assessment, it can therefore be determined that the construction stage traffic will have a ***direct***, ***short-term, negative*** and ***imperceptible*** effect on human health and the operational stage traffic will have a ***direct***, ***long-term, negative*** and ***imperceptible*** effect on human health, which is overall not significant in EIA terms.

Emissions of air pollutants during the operational phase are predicted to be significantly below the ambient air quality standards, which are based on the protection of human health. Therefore, residual effects to human health related to air quality will be ***direct, long-term, negative*** and ***not significant***, which is overall not significant in EIA terms.

11.8 Indirect and/or Secondary Impacts

The significance of effect of the impacts assessed has been described in terms of direct or indirect effects in Sections **11.5** and **11.7**. All impacts assessed will have direct effects, and there are no other residual indirect and/or secondary effects as a result of the proposed development.

11.9 Monitoring

The assessment of impacts on air quality as a result of the construction and operational phases of the proposed development are predicted to be not significant in EIA terms. Monitoring in the form of visual inspections for nuisance dust has been outlined in **Section 11.6.1**. Based on the predicted impacts it is concluded that no additional specific monitoring is required.

11.10 Interactions

11.10.1 Population and Human Health

Air quality does not have a significant number of interactions with other topics. The most significant interactions are between population and human health (Chapter 4 – Population & Human Health) and air quality. An adverse impact due to air quality in either the construction or operational phase has the potential to cause health and dust nuisance issues. The mitigation measures that will be put in place by the proposed development will ensure that the effects of the proposed development complies with all ambient air quality legislative limits. Therefore, the predicted effect is direct, short-term, negative and not significant with respect to population and human health during the construction phase and direct, long-term, negative and not significant during the operational phase, which is overall not significant in EIA terms.

11.10.2 Traffic and Transportation

Interactions between air quality and traffic (Chapter 14 - Traffic and Transportation) can be significant. With increased traffic movements and reduced engine efficiency, i.e. due to congestion, the emissions of vehicles increase. The effects of the proposed development on air quality are assessed by reviewing the change in annual average daily traffic on roads close to the site. In this assessment, the effects of the interactions between traffic and air quality are considered to be direct, long-term, negative and imperceptible, which is overall not significant in EIA terms.

11.10.3 Climate

Air quality and climate have interactions due to the emissions from the burning of fossil fuels during the construction and operational phases generating both air quality and climate effects. Air quality modelling outputs are utilised within Chapter 12 - Climate. There is no impact on climate due to air quality however the sources of impacts on air quality and climate are strongly linked.

11.10.4 Land, Soils and Geology

Construction phase activities such as land clearing, excavations, stockpiling of materials etc. have the potential for interactions between air quality and land and soils in the form of dust emissions. With the appropriate mitigation measures to prevent fugitive dust emissions, it is predicted that there will be no significant interactions between air quality and land, soils and geology (Chapter 9 - Land, Soils and Geology).

11.10.5 Biodiversity

There is the potential for interactions between air quality and biodiversity (Chapter 8 - Biodiversity). Dust generation can occur during extended dry weather periods as a result of construction traffic. Dust suppression measures (e.g. dampening down) will be implemented as necessary during dry periods and vehicle wheel washes will be installed, for example. The works involve stripping of topsoil and excavations, which will remove some vegetation such as trees and scrub. It will also generate dust and potentially effect on the air quality in the locality. However, the generation of dust will be temporary during construction phase and is not anticipated to have a significant effect on biodiversity. Once the mitigation measures outlined within Chapter 11 are implemented dust related effects are predicted to be direct, short-term, negative and not significant, which is overall not significant in EIA terms.

11.11 Cumulative Impacts

This section assesses the cumulative impacts from the proposed development on air quality during its construction and operation, in line with the methodology presented in **Chapter 21 Cumulative Impacts** and considering the long list of “other existing and/or approved projects” within.

11.11.1 Construction Phase

According to the IAQM guidance (2024) should the construction phase of the proposed development coincide with the construction of any other permitted developments within 500 metres of the site then there is the potential for cumulative dust impacts to the nearby sensitive receptors. Should simultaneous construction phases occur, it would lead to cumulative dust soiling and dust-related impacts on human health, specifically localised to the works area associated with the proposed works.

A review of the planned and permitted projects within the vicinity of the site was undertaken and is described in **Chapter 21 Cumulative Impacts**. **Table 11.28** presents the planned and permitted projects which are within 500 m of the proposed development and with construction phases which could lead to cumulative construction dust impacts.

All other developments are outside the 500 m cumulative zone of influence and have been scoped out of cumulative assessment, as there no direct or indirect significant negative cumulative effects predicted between these projects and the proposed development on air quality.

Project No.	Project Name / Type	Within 500 m of Proposed Development?	Cumulative Significance of Effect
1	Acorn Recycling Workshop and Truck Washout	Yes	Direct, short-term, negative and not significant
2	Irish Bioeconomy Foundation Research and Development Unit	Yes	Direct, short-term, negative and not significant
3	Glanbia Biorefinery (1)	Yes	Direct, short-term, negative and not significant
4	Glanbia Biorefinery (2) (Modifications to Application Reg. Ref. 18601296)	Yes	Direct, short-term, negative and not significant
5	Soleirtricity Solar PV Farm	Yes	Direct, short-term, negative and not significant

Table 11.28: Projects Screened In for Cumulative Assessment of Construction Phase Air Quality Impacts

There is the potential for cumulative construction dust effects should the construction phases overlap with that of the proposed development. However, the dust mitigation measures outlined in **Section 11.6.1** will be applied throughout the construction phase of the proposed development which will avoid significant cumulative effects on air quality. With appropriate mitigation measures in place, the predicted residual cumulative effect on air quality associated with the construction phase of the proposed development are considered ***direct***, ***short-term, negative*** and ***not significant***, which is overall not significant in EIA terms.

11.11.2 Operational Phase

Air Dispersion Modelling

As detailed in Section 11.3.2 – Process Emissions, the potential for cumulative impact of the emissions from the proposed development with the projects presented in **Chapter 21 Cumulative Impacts** and with Industrial Emissions (IE) licenced or Integrated Pollution Control (IPC) installations has been considered, in line with the methodology of AG4 (EPA, 2020). There is one EPA licenced installation near the facility, Lisheen Renewable Energy Limited (P1199-01 – licence in 'Applied' status), with the potential for cumulative impact with the proposed development.

Additionally, the permitted Glanbia Biorefinery (planning application Ref. 18601296) will operate a CHP, 2 no. backup boilers and 3 no. dryers and will be subject to an IE licence in the future. However, no documentation is available with emissions information for these sources as part of the planning application. These sources could therefore not be included in the cumulative assessment. The non-technical summary for the Glanbia Biorefinery EIAR notes no impacts on air quality from the facility and therefore it is unlikely to result in a significant effect on air quality in combination with the proposed development and the Lisheen Renewable Energy Limited installation.

NO_2

The NO_2 modelling results at the worst-case receptor (at the site boundary) are detailed in **Table 11.29**. The results indicate that the ambient ground level concentrations are in compliance with the relevant air quality standards for NO_2. For the worst-case year, emissions from the site lead to an ambient NO_2 concentration (including background) which is 47% of the maximum ambient 1-hour limit value (measured as a 99.8th percentile) and 33% of the annual limit value at the worst-case receptor (at the site boundary). The locations of the maximum concentrations for NO_2 are close to the boundary of the site with concentrations decreasing with distance from the facility.

The geographical variations in ground level NO_2 concentrations beyond the facility boundary for the worst-case years modelled are illustrated as predicted environmental concentration [PEC] contours in **Figure 11.9** and **Figure 11.10**, to demonstrate the direction and extent of the emission plume.

In summary, emissions to atmosphere of NO_2 from the site will be in compliance with the ambient air quality standards which are based on the protection of the environment and human health. Therefore, the effect of the proposed development in terms of NO_2 can be considered ***direct***, ***negative, long-term*** and ***slight***, which is overall not significant in EIA terms.

Pollutant/ Year	Averaging Period	Process Contribution (µg/m^3)	Background (µg/m^3)	Predicted Emission Concentration (µg/m^3)	Standard (µg/m^3) Note 1	PEC as a % of Limit Value
NO_2/2019	Annual mean	8.2	5	13.2	40	33%

Pollutant/ Year	Averaging Period	Process Contribution (µg/m³)	Background (µg/m³)	Predicted Emission Concentration (µg/m³)	Standard (µg/m³) Note 1	PEC as % of Limit Value
	99.8th%ile of 1-hr means	83.1	10	93.1	200	47%
NO_2/2020	Annual mean	7.8	5	12.8	40	32%
	99.8th%ile of 1-hr means	83.4	10	93.4	200	47%
NO_2/2021	Annual mean	7.8	5	12.8	40	32%
	99.8th%ile of 1-hr means	82.5	10	92.5	200	46%
NO_2/2022	Annual mean	7.8	5	12.8	40	32%
	99.8th%ile of 1-hr means	84.2	10	94.2	200	47%
NO_2/2023	Annual mean	7.6	5	12.6	40	32%
	99.8th%ile of 1-hr means	82.8	10	92.8	200	46%

Table 11.29: Cumulative – Dispersion Model Results for Nitrogen Dioxide [NO_2].

Note 1 Air Quality Standards 2022 (from EU Directive 2008/50/EC and S.I. 739 of 2022).

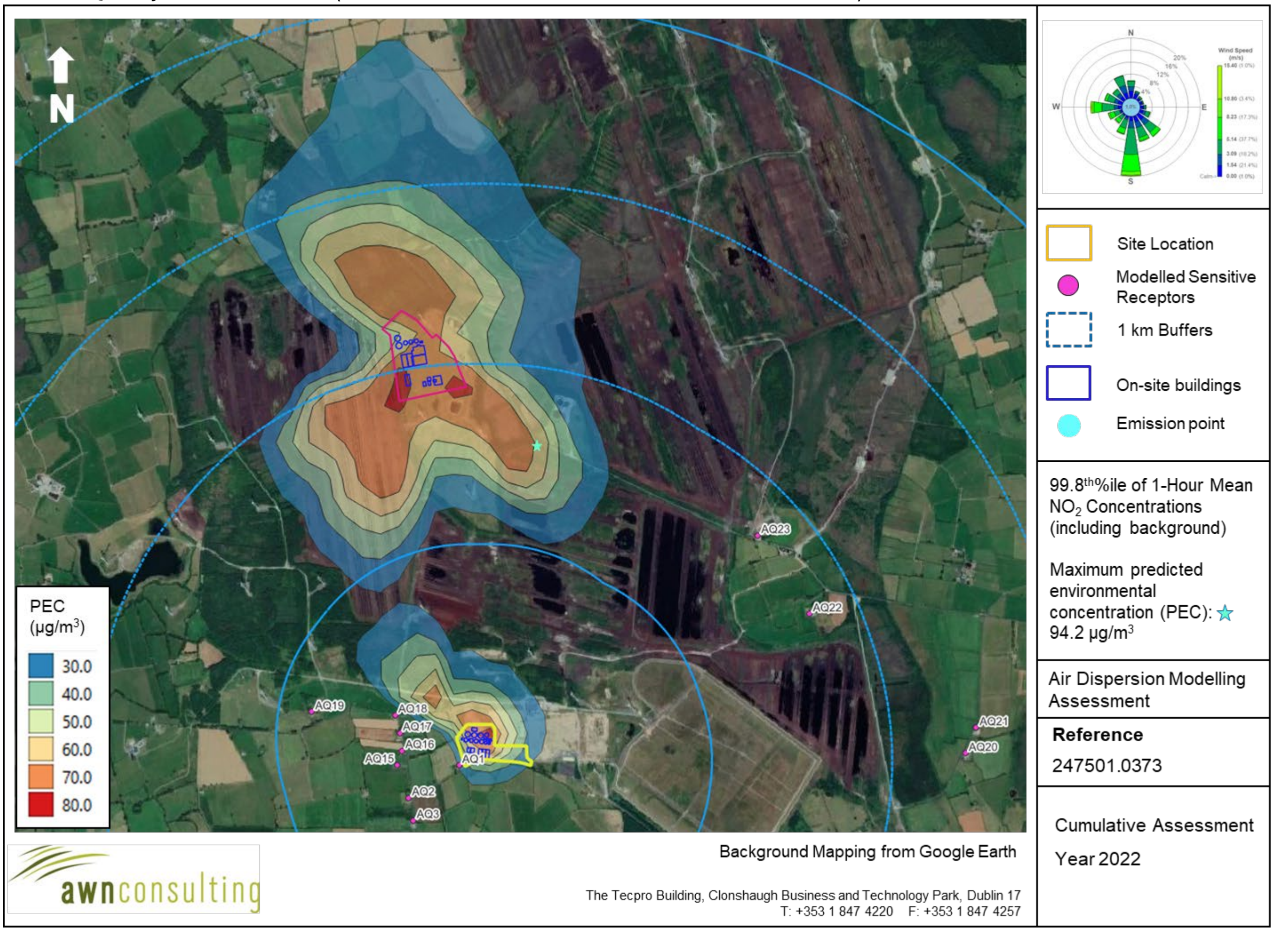

Figure 11.9: Cumulative – Maximum 1-Hour NO_2 Concentrations (as 99.8th%ile) (µg/m³).

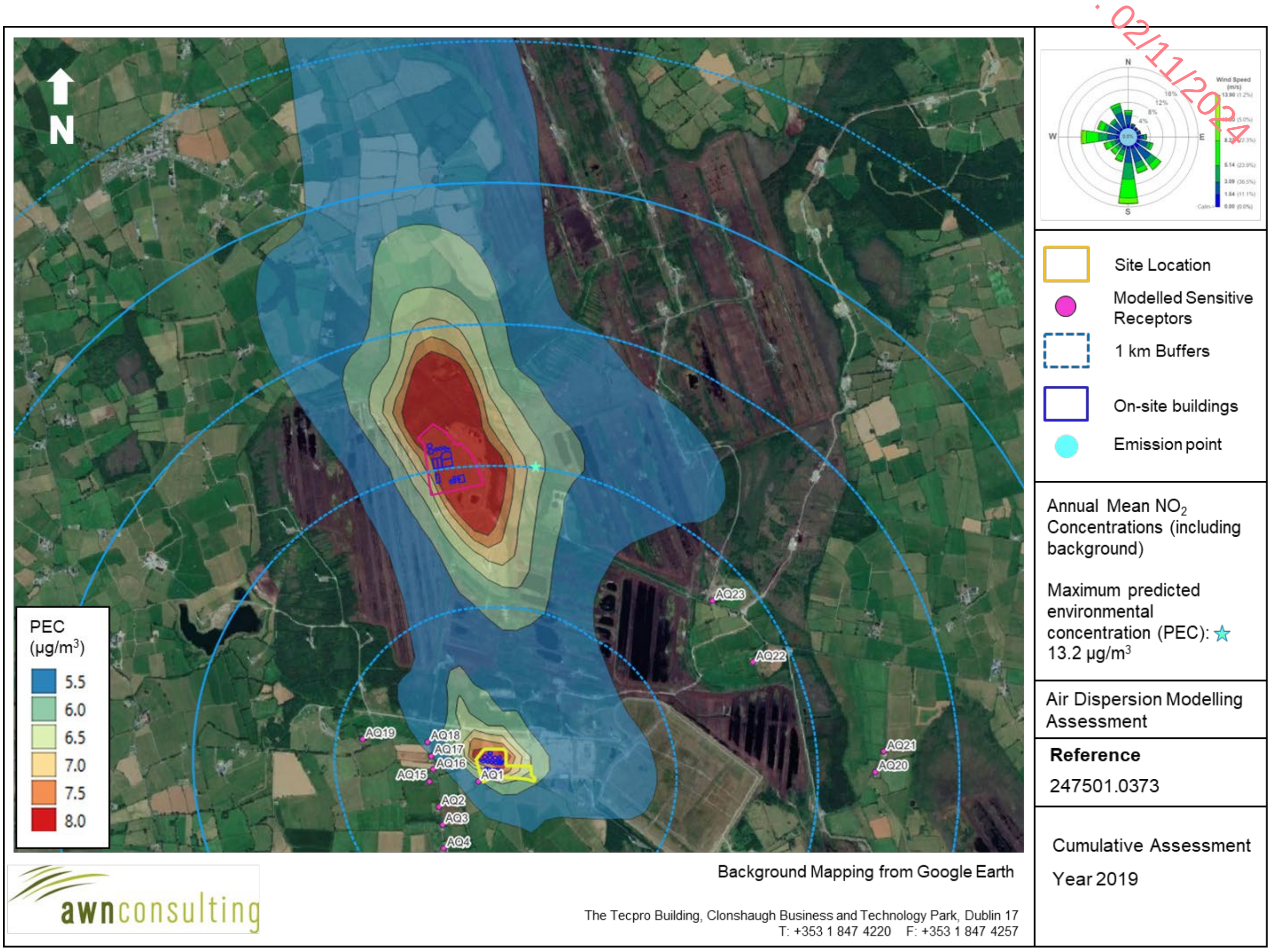

Figure 11.10: Cumulative – Annual Mean NO_2 Concentrations (μg/m³).

Impact on Designated Habitat Sites

The ecological habitat site closest to and most impacted by the facility, and where the highest modelled concentrations are predicted, is the Nore Valley Bogs NHA.

The NO_X modelling results are detailed in **Table 11.30**. Emissions from the facility lead to an ambient NO_X concentration (including background) which is at most 10% of the annual limit value the worst-case location within the designated sites over the five years of meteorological data modelled. The effects of NO_X on designated sites due to the proposed operations of the facility are ***direct, long-term, negative*** and ***not significant***, which is overall not significant in EIA terms.

Pollutant/ Year	Averaging Period	Process Contribution (PC) NO_X (μg/m³)	Background (μg/m³)	Predicted Emission Concentration (PEC) NO_X (μg/m³)	Limit Value (μg/m³)	PEC as a % of Limit Value
NO_X/2019	Annual mean	0.13	2.8	2.93	30	10%
NO_X/2020	Annual mean	0.12	2.8	2.92	30	10%

Pollutant/ Year	Averaging Period	Process Contribution (PC) NO_X (µg/m³)	Background (µg/m³)	Predicted Emission Concentration (PEC) NO_X (µg/m³)	Limit Value (µg/m³)	PEC as a % of Limit Value
NO_X/2021	Annual mean	0.15	2.8	2.95	30	10%
NO_X/2022	Annual mean	0.11	2.8	2.91	30	10%
NO_X/2023	Annual mean	0.13	2.8	2.93	30	10%

Table 11.30: Cumulative – NO_X Designated Habitat Dispersion Model Results.

In order to consider the effects of nitrogen and acid deposition (as N) owing to emissions from the facility on the designated habitat sites, the maximum annual mean NO_2 predicted environmental concentrations are converted into the dry deposition fluxes and then nitrogen and acid deposition (as N) fluxes (as described in **Section 11.3.2.2 Designated Habitat Sites**) and shown in **Table 11.4**.

The nitrogen deposition flux for the worst-case year is 6.449 kg/ha/yr, shown in **Table 11.31**, and is within the range in worst-case critical loads of 5-10 kg/ha/yr (APIS, 2023) for the habitat type "Raised and blanket bogs" in the Nore Valley Bogs NHA, indicating that the effects of nitrogen deposition on designated sites due to the proposed operations of the facility are ***direct, long-term, negative*** and ***not significant***, which is overall not significant in EIA terms.

Year	NO_2 Annual Mean PC (µg/m3)	Dry Deposition Flux (µg/m²/s)	PC Nitrogen Deposition Flux (kg/ha/year)	APIS Background Nitrogen Deposition (kg/ha/yr)	PEC Nitrogen Deposition kg/ha/yr
2019	0.12	0.0002	0.02	7.3	7.317
2020	0.11	0.0002	0.02	7.3	7.315
2021	0.13	0.0002	0.02	7.3	7.319
2022	0.10	0.0001	0.01	7.3	7.314
2023	0.12	0.0002	0.02	7.3	7.317

Table 11.31: Cumulative – Nitrogen Deposition Designated Habitat Dispersion Model Results.

The acid deposition (as N) flux for the worst-case year is 0.501 keq/ha/yr, shown in **Table 11.32**, and is below the worst case maximum critical load range of 0.286 – 5.057 keq/ha/yr for the habitat "Raised and blanket bogs" in the Nore Valley Bogs NHA (APIS, 2023), indicating that the effects of acid deposition (as N) on designated sites due to the proposed operations of the facility are ***direct, long-term, negative*** and ***not significant***, which is overall not significant in EIA terms.

Year	NO_2 Annual Mean PC (µg/m3)	Dry Deposition Flux (µg/m²/s)	PC Acid Deposition keq/ha/yr	APIS Background Acid Deposition (keq/ha/yr)	PEC Acid Deposition (as N) keq/ha/yr)
2019	0.12	0.0002	0.001	0.5	0.501
2020	0.11	0.0002	0.001	0.5	0.501
2021	0.13	0.0002	0.001	0.5	0.501

Year	NO_2 Annual Mean PC (µg/m3)	Dry Deposition Flux (µg/m²/s)	PC Acid Deposition keq/ha/yr	APIS Background Acid Deposition (keq/ha/yr)	PEC Acid Deposition (as N) keq/ha/yr)
2022	0.10	0.0001	0.001	0.5	0.501
2023	0.12	0.0002	0.001	0.5	0.501

Table 11.32: Cumulative – Acid Deposition Designated Habitat Dispersion Model Results.

Residual Cumulative Impact

As the operational phase traffic has been scoped out of a detailed air quality assessment, it can therefore be determined that the potential cumulative operational stage traffic and future baseline traffic will have a residual ***direct***, ***long-term, negative*** and ***imperceptible*** effect on air quality, which is overall not significant in EIA terms.

The results of the dispersion modelling presented in the preceding sections indicate that all ambient ground level concentrations are below the relevant air quality standards, therefore no additional mitigation measures are required. The residual effect of the cumulative emissions to air during the operational phase is considered ***direct, long-term, negative*** and ***not significant***, which is overall not significant in EIA terms.

11.12 Difficulties Encountered

There were no difficulties encountered in compiling this assessment.

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