9 Air, Odour and Climate

9.1 Introduction

This air quality chapter describes the outcomes of the air quality, odour and climate impact assessment that was carried out to assess the possible impacts from the Construction and Operational stages of the Proposed Development with respect to relevant guidelines.

The likely impacts on air quality and climate from the construction phase of the planned development have been qualitatively evaluated. The outcomes of this assessment were used to suggest appropriate mitigation measures to be employed during the construction phase to reduce potential impacts.

With regard to the operational phase, air dispersion modelling was completed to assess the impact of emissions from the planned air and odour emissions points associated with the Anaerobic Digestion Facility to local ambient air quality pollutant concentrations. The location and highest of the worst-case ground level concentrations for each pollutant were also identified.

The proposed development comprises the construction of an anaerobic digestion facility to produce renewable biomethane, CO_2 (which will be captured), and a bio-based fertiliser from organic material. The total proposed gross floor area of the development (including internal plant areas and ancillary structures) will be c. 5,903 sq.m.

The development will consist of the following:

- Construction of 2 no. primary digesters (with an overall height of c. 9.1m), a pump house (with a gross floor area (GFA) of c. 279.8 sq.m), and 2 no. post digester tanks (with an overall height of c. 9.1m), located in the northeastern section of the site.
- Construction of 2 no. prepits (c. 4.8m in height), a pasteurisation buffer tank (c. 4.8m in height), and a pasteurisation unit (with a maximum height of c. 4.2m), located west of the primary digesters, within the northern section of the site.
- Construction of a digestate storage tank (c. 11.3 in height) located centrally on site, to the south of the primary and post digester tanks.
- Construction of a digestate treatment building and a feedstock reception building (with a height of c. 12m and a GFA of c. 2,797.2 sq.m) with odour abatement system (with a height of c. 11.0m to odour abatement stack), located in the northwestern section of site.
- Construction of combined heat and power (CHP) unit (c. 2.6m in height and c. 5.6m in height to flue, with a GFA of c. 38.53 sq.m), a biogas boiler (c. 2.6m in height and c. 5.6m in height to flue, with a GFA of c. 12.74 sq.m), a backup boiler (c. 2.6m in height), a gas treatment system (c. 4.2m in height), a biomethane compression system (c. 4.2m in height), and a safety flare (c. 11.3m in height), located south of the digestate storage tank, in the south-east section of the site.
- Construction of a CO2 liquefactor (with an overall height of c. 10.7m to top of storage vessels), a propane tank compound accommodating 2 no. propane tanks (c. 1.6m in height), and an ESB substation (with a GFA of c. 23.5 sq.m and a height of c. 3.4m), located in the south-eastern section of the site.
- Construction of roofed silage clamps (with a GFA of c. 2,424 sq.m and a height of c. 8.7m) and a fuel storage tank (c. 2m in height), located in the western section of the site.

- Construction of a two storey office building (with a GFA of c. 327.4 sq.m and a height of c. 11m) within the western section of the site, adjacent to the site entrance.
- Alterations to the adjacent local road including a new site entrance and access arrangements, provision of a passing bay, boundary setbacks and replacement planting, and road improvements to allow for improved access and safety.
- Associated and ancillary works including parking (8 no. standard, 3 no. EV and 1 no. accessible parking spaces and bike storage for 10 no. bikes), a new site entrance and gate, a weighbridge, solar PV arrays at roof level, wastewater treatment equipment, bunding and surface treatments, attenuation pond, boundary treatments, lighting, services, lightning protection masts, drainage, landscaping, and all associated and ancillary works.

9.2 Consultation

ORS have been commissioned to assess the potential effects of the Proposed Development in terms of air quality/climate and odour during the construction and operational phases.

The principal members of the ORS EIA team involved in this assessment include the following persons:

- **Project consultant and Lead-Author:** Andrew Evans – B.A. (Geography & Economics), MSc. (Sustainability & Green Technologies) (Current Role: Environmental Consultant. Experience *ca.* 7 years.
- **Project Consultant and Co-Author:** Christopher Carr (Irwin Carr) – B.Sc. (Environmental Health), Post-Grad Diploma (Acoustics & Noise Control), MIAQM, MIEnvSc. Current Role: Consultant. Experience *ca.* 11 years.
- **Project Lead & Reviewer:** Oisín Doherty – B.Sc. (Geography with Environmental Science), MSc. (Environmental Management), CEnv, MIEnvSc. Current Role: Senior Environmental Consultant. Experience ca. 15 years.

Consultation between ORS and other members of the planning/design team was undertaken in order to obtain information required to assess the potential construction and operational phase effects on local air quality and climate.

9.3 Assessment Methodology and Significance Criteria

9.3.1 Desktop Study

A desk-based assessment method was used to assess baseline air quality for the receiving environment of the proposed site. The baseline information that is detailed in this section of the assessment was obtained from publicly available sources.

The following documents and sources were referenced:

- EPA Ambient Air Monitoring Station Data (EPA web page)
- Air Quality in Ireland Reports 2017 – 2023 (EPA web page)
- Meteorological Data 2017 – 2024 (Met Éireann)
- Composting and Anaerobic Digestion Association of Ireland (CRÉ)
- Local Terrain Data (OSI)
- Government of Ireland (2024) Climate Action Plan 2024

- Transport Infrastructure Ireland (2011) Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes (DoEHLG)
- Other Maps and plans published by the Ordnance Survey of Ireland (OSI)
- UK Highways Agency (2007) Design Manual for Roads and Bridges, Volume 11, Section 3, Part 1 - HA207/07 (Document and Calculation Spreadsheet)
- World Health Organisation (2006) Air Quality Guidelines - Global Update 2005 (and previous Air Quality Guideline Reports 1999 and 2000)
- Institute of Air Quality Management (IAQM) (2024) Guidance on the Assessment of Dust from Demolition and Construction Version 2.2
- Reports, maps and data published by the Environmental Protection Agency (EPA).
- Hanrahan, P (1999a) The Plume Volume Molar Ratio Method for Determining NO2/NOX Ratios in Modelling – Part 1: Methodology J. Air and Waste Management Assoc. 49 1324-1331
- Hanrahan, P (1999b). The Plume Volume Molar Ratio Method for Determining NO2/NOX Ratios in Modelling – Part 21: Evaluation Studies J. Air and Waste Management Assoc. 49 1332-1338
- UN Economic and Social Council, Executive Body for the Convention on Long-Range Transboundary Air Pollution, ECE/EB.AIR/WG.5/2007/3
- Limerick County Development Plan 2022 - 2028

9.3.2 Assessment Methodology and Significance Criteria

This chapter was prepared using the following guidance documents:

- Institute of Air Quality Management (IAQM) (2024) Guidance on the Assessment of Dust from Demolition and Construction Version 2.2.
- Biosurf - S. Majer, K. Oehmichen and F. Kirchmeyr (2016) D5.3 Calculation of GHG Emission Caused by Biomethane.
- EPA, (2022) Ireland's Provisional Greenhouse Gas Emissions
- EPA, (2024) Ireland's Greenhouse Gas Emissions Projections
- Economic Assessment of Biogas and Biomethane in Ireland, SEAI
- EPA, (2022). Guidelines on the Information to be Contained in Environmental Impact Assessment Reports.
- EPA (2020) Air Dispersion Modelling from Industrial Installations Guidance Note (AG4).
- EPA (2021) Air Guidance Note 5 (AG5) Odour Impact Assessment Guidance for EPA Licensed Sites.
- EPA (2019) Odour Emissions Guidance Note (Air Guidance Note AG9)
- Transport Infrastructure Ireland (2011) Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes.
- UK DEFRA (2018) Part IV of the Environment Act 1995: Local Air Quality Management (LAQM) Technical Guidance (TG16).
- UK DEFRA (2016a) Part IV of the Environment Act 1995: Local Air Quality Management (LAQM). Policy Guidance (PG16).
- UK Highways Agency (2007) Design Manual for Roads and Bridges, Volume 11, Section 3, Part 1 - HA207/07 (Document and Calculation Spreadsheet).
- Clean Air for Europe (CAFÉ) Directive 2008/50/EC.
- S.I. No.180 of 2011, Air Quality Standards (AQS) Regulations 2011.
- UK Dep. BEIS Combined Heat and Power – Environmental A detailed guide for CHP developers – Part 3

Detailed legislation and standards relating to air quality and odour relevant to the evaluation are addressed in the sections below.

The significance criteria used throughout this assessment to rate the impacts to air quality, odour and climate are based on those outlined within the EPA Guidance document Guidelines on the information to be contained in Environmental Impact Assessment Reports (2022).

Construction Emissions – Applicable Limit Values for Dust and Dust Deposition

The EU ambient air quality standards outlined in **Table 9.1** have set ambient air quality limit values for PM_{10} and $PM_{2.5}$ dust particles which are less than 10 microns and are of greatest concern when considering human health.

In relation to larger dust particles fractions that can give rise to unwanted dust spoiling, there are no statutory guidelines regarding the maximum dust deposition levels that may be generated during the construction phase of a development in Ireland.

Generally, the German TA-Luft standard for dust deposition (non-hazardous dust) (German VDI, 2002) is applied and states a maximum permissible emission level for dust deposition of 350 mg/m^2/day averaged over a one-year period at any receptors outside the site boundary.

Recommendations from the Department of the Environment, Heritage and Local Government (DOEHLG, 2004) apply the Bergerhoff limit of 350 mg/m^2/day to the site boundary of quarries. This limit value can be applied with regard to dust impacts from construction of the development.

Construction Emissions – Methodology for Assessing Ambient Air Impacts

During the construction stage of the Proposed Development the most likely effect on air quality will be from construction dust emissions (nuisance dust and PM_{10}/$PM_{2.5}$ emissions) associated with activities such as excavations, infilling materials, stock piling and movement of vehicles. For the purposes of this assessment the Institute of Air Quality Management (IAQM) construction dust guidance (IAQM, 2024) was utilized.

To assess the potential effects accordingly, construction activities are divided into 4 categories:

- Demolition (not required in this assessment)
- Earthworks
- Construction; and
- Trackout (described as the transport of dust and dirt from the construction / demolition sites onto public road network, where it may be deposited and then re-suspended by vehicles using the network).

A qualitative assessment of construction dust has been undertaken in line with the IAQM 2024 guidance. The study area for this assessment was 250m from the Proposed Development boundary and or within 50m of the roads used by construction vehicles on the public road up to 250m from the site entrance.

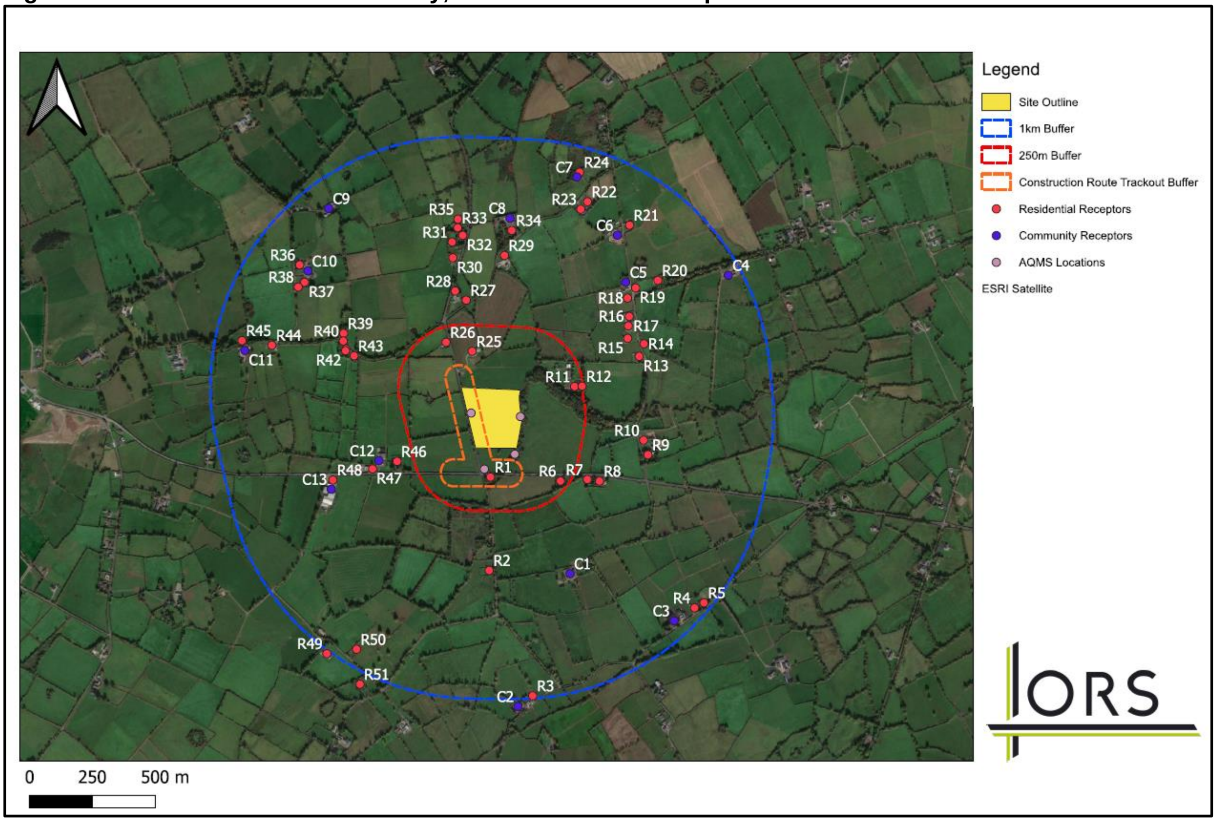
The first stage is to assess the requirement for an evaluation. The requirement for an assessment is based on distances of human and/or ecological receptors of the site.

There are six human receptors are within 250m of the site boundary with one of those also being within 50m of the trackout route; consequently, construction dust does have the potential to cause an effect on these receptors. No designated ecological receptors are within 50m of the trackout route or site boundary; therefore, construction dust will not have the potential to adversely effect ecological receptors.

The nearest human and residential receptor to the site is a residential house located approximately 120m South of the proposed site boundary. Dust will be created during the construction of the Proposed Development which may have adverse effects on local sensitive receptors e.g., residents living nearby.

The construction dust assessment study area including identified receptors is included as part of **Figure 9.1.**

Figure 9.1: Site construction boundary, buffer zones and receptor locations



The effect of construction on site has been assessed qualitatively to evaluate the risk of dust effects and decide suitable mitigation measures to control risk appropriately. The degree of mitigation advised for each activity is then established, being proportionate with the associated risk (Low, Medium or High risk). In accordance with the IAQM construction dust guidance, mitigation is advised for all risk levels.

Construction phase traffic also has the potential to affect air quality and climate. The UK DMRB guidance (UK Highways Agency, 2007), states that road links meeting one or more of the following criteria (described below) can be defined as being 'affected' by a Proposed Development and should be included in the local air quality assessment. The use of the UK guidance is recommended by the TII (2011) in the absence of specific Irish guidance, this approach is considered best practice and 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;
- A change in speed band;
- A change in carriageway alignment by 5m or greater.

The construction stage traffic will not increase current levels by 1,000 AADT or 200 HDV AADT and therefore does not meet the above scoping criteria. Consequently, a detailed air assessment of construction stage traffic emissions has been scoped out from any further assessment as there is no potential for significant effects to air quality.

Odour Emissions

Appendix 9.4 gives background on odour as a nuisance and describes how the possibility for odour occurrences were evaluated for this EIAR. Dispersion modelling has been employed to calculate the impacts of the Proposed Development on the neighbouring environment with respect to odour and the assessment has been completed with reference to the EPA guidance document titled EPA Air Dispersion Modelling Guidance Note (AG4), (EPA, 2020). Dispersion modelling information regarding input and methodology are described in **Section 9.3.4**.

A full description of the odour abatement system can be found in **Chapter 2 Section 2.2.10.**

The UK Environment Agency (Environment Agency, 2011 and adapted for Irish EPA use) has published detailed guidance on appropriate odour threshold levels based in part on the offensiveness of the odour. Specific exposure criteria with respect to the "annoyance potential" which is described as "the likelihood that a specific odorous mixture will give reasonable cause for annoyance in an exposed population". Three categories are used to rank industrial sources with regard to their offensiveness, these are "low", "medium" and "high" with exposure criteria linked to each category. Exposure criteria range from 1.5OUE/m^3 for highly offensive sources, 3.0 OUE/m^3 for moderately offensive sources to 6.0 OUE/m^3 for the least offensive sources. There are no details with regard to an anaerobic digestion facility and affiliated odour treatment system covered, however, it is expected to be of medium to high offensiveness, therefore the exposure criteria are classified as worst case at 1.5 OUE/m^3.

Process Emissions

Carbon monoxide (CO), nitrogen oxides (as NO_2) and odour will be emitted from the development during the operational stage and have been included as part of the ambient baseline monitoring and air dispersion modelling. Sulphur dioxide (SO_2), VOCs, hydrogen sulphide (H_2S), ammonia (NH_3), PM_{10} and $PM_{2.5}$ were not modelled and only included in the baseline modelling as there is no emissions expected of these pollutants. This will be covered in more detail in **Section 9.3.4**.

Details with respect to ambient air quality pollutants are covered below, these sections also cover the assessment for the potential for ambient air quality impacts. Ambient air quality impacts from the Proposed Development on the local environment have been determined using air dispersion modelling, this modelling has been completed in conjunction and compliance with Air Dispersion Modelling from Industrial Installations Guidance Note (AG4), (EPA, 2020).

Ambient Air Quality Standards

National and European statutory bodies have established limit values in ambient air for a variety of pollutants to safeguard and minimise the risk to human health. These limit values are referred to as "Air Quality Standards" and are derived from health and environmental factors. Refer to **Table 9.1** and **Table 9.2** below.

Suitable standards or limit values are applied in terms of compliance to gauge air quality significance criteria. The relevant standards which apply to Ireland include the Air Quality Standards Regulations 2011 (S.I. No 180 of 2011), which transposed the requirements of Directive 2008/50/EC on ambient air quality and cleaner air for Europe which outlines limit values for the pollutants NO_2, PM_{10}, and $PM_{2.5}$.

Directive 2008/50/EC merges the previous Air Quality Framework Directive (96/62/EC) and its successive daughter directives (including 1999/30/EC and 2000/69/EC) and includes ambient limit values describing $PM_{2.5}$.

With regard to VOCs, the limit for benzene has been used for the purpose of this project and a worst-case assumption made that all VOCs released are benzene. In reality, there will be a variety of VOCs within the process emissions, not limited to benzene. The limit value for benzene has been employed as it is the only VOC with a legislated ambient air quality standard (**see Table 9.1**), the limit value is also quite stringent which makes this approach extremely conservative and robust and grossly overestimates the effect and significance of VOCs.

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

Pollutant	Regulation (Note 1)	Limit Type	Value
Nitrogen Dioxide	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	200 µg/m³ NO_2
		Annual limit for protection of human health	40 µg/m³ NO_2
		Critical limit for protection of vegetation	30 µg/m³ NO + NO_2
Sulphur dioxide	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 24 times/year	350 µg/m³
		Daily limit for protection of human health - not to be exceeded more than 3 times/year	125 µg/m³
		Annual and Winter critical level for the protection of ecosystems	20 µg/m³
Carbon Monoxide	2008/50/EC	8-hour limit (on a rolling basis) for protection of human health	10 mg/m³ (8.6 ppm)
Benzene*	2008/50/EC	Annual Limit Value for protection of human health	5 µg/m³

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/m³ PM10
		Annual limit for protection of human health	40 µg/m³ PM10
$PM_{2.5}$	2008/50/EC	Annual limit for protection of human health	25 µg/m³ PM2.5

* Expressed as Volatile Organic Compounds (VOCs) in this assessment for worst case analysis.

Table 9.2: EA, UN and EPA Ambient Air Quality Standards

Pollutant	Guidance	Limit Type	Value
Ammonia*	EA, UK H1 Part 2	1-hour average 100%ile	< 2,500 µg/m³
		Annual average	< 180 µg/m³
	UNESC	Annual average for protection of sensitive lichens / bryophytes	< 1 µg/m³
		Annual average for the protection of woodland / heath lands	< 3 µg/m³
Hydrogen sulphide	EA, UK H1 Part 2	1-hour average 100%ile	< 140 µg/m³
		Annual average	< 150 µg/m³
Odour	Irish EPA AG4 & AG9	Expressed as 1 hr average at the 98%ile	< 1.50 OuE/m³

* Source UN Economic and Social Council, Executive Body for the Convention on Long-Range Transboundary Air Pollution, ECE/EB.AIR/WG.5/2007/3

Methodology for Assessing Ambient Air Effects – Operational Traffic Emissions

Assessment of operational traffic emissions associated with the Proposed Development was carried out using the UK DMRB spreadsheet. The modelling assessment determined that the change in emissions of NO_2 and PM_{10} at the nearby sensitive receptor road link because of the Proposed Development will be imperceptible. Therefore, the operational phase effect to air quality is **long-term, localised, neutral and imperceptible** (see **Section 9.3.4** for more detail).

The evaluation of air quality affects from traffic (both operational and construction) was considered utilising methodology proposed by the UK DEFRA (2016b). This approach involves modelling by way of the UK DMRB Screening Model (Version 1.03c, July 2007), the NOx to NO_2 Conversion Spreadsheet (Version 6.1, October 2017) (UK DEFRA, 2017), and following guidance issued by the TII (2011), UK Highways Agency (2007), UK DEFRA (2016a; 2016b; UK DETR 1998) and the EPA (2015; 2017).

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

- Concentrations exceed 90% of the air quality limit values when assessed by the screening method; or

- Sensitive receptors exist within 50m of a complex road layout (e.g. grade separated junctions, hills etc).

The UK DMRB guidance – UK Highways (LA 105, 2019 and 2007 guidance), on which the TII guidance (2011) is based, states that road links meeting one or more of the following criteria can be defined as being 'affected' by a Proposed Development and should be included in the local air quality assessment:

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

Guidance from Transport Infrastructure Ireland (TII, 2011) advises the use of the UK Highways Agency DMRB spreadsheet tool for evaluating the air quality effects from road schemes. The DMRB spreadsheet tool was last reviewed in 2007 and allows for modelled years up to 2025. Vehicle emission standards up to Euro V are contained but since 2017, Euro 6d standards are appropriate for the new fleet. In addition, the model does not allow for electric or hybrid vehicle use. Therefore, this is a slightly outdated assessment tool. The LA 105 guidance document states that the DMRB spreadsheet tool may still be used for simple air quality assessments where the possibility of exceeding the air quality standards is low. Due to its use of a "dirtier" fleet, vehicle emissions would be higher than more modern models and therefore any results will be robust in nature and will deliver a worst-case assessment.

9.3.3 Field Survey

Onsite monitoring (and subsequent lab analysis as necessary) was carried out for the below parameters to evaluate background levels for the site. To remain as conservative and robust as possible figures obtained from EPA monitoring were utilised, as per AG4, which are greater than results obtained from the onsite monitoring. Onsite results for NH_3 and H_2S were utilised in the absence of data generated from EPA monitoring locations. Data from the Portlaoise monitoring station was utilised for the Carbon Monoxide values and data from the Askeaton monitoring station was utilised for the $PM_{10/2.5}$ values. Fieldwork was completed September/October 2024 and consisted of the following elements;

- $PM_{2.5}$ and PM_{10} Monitoring (EPA Monitoring Station)
- NO, NO_2 and NOx Monitoring
- SO_2 Monitoring
- H_2S Monitoring
- NH_3 Monitoring
- CO Monitoring (EPA Monitoring Station)

Table 9.3: Baseline Air Quality Monitoring Data in the Vicinity of Proposed Plant

Compound	Site specific baseline monitoring 12th Sep 24 to 09th Oct 24
Carbon Monoxide 8-hr (Annual Mean) (1 Location)	0.8 (mg/m^3)
Oxides of Nitrogen (Annual Mean) (4 locations)	Avg. 3.67 (Min 2.97 - Max 4.65) (µg/m^3)
Sulphur Dioxide (Annual Mean) (4 locations)	Avg. < 0.11 (Min/Max < 0.11 (LOD)) (µg/m^3)

Particulate matter as PM_{10} (Annual Mean) (1 Location)	Avg. 8.40 (Min 0.65 - Max 38.41) (µg/m³)
Particulate matter as $PM_{2.5}$ (Annual Mean) (1 Location)	Avg. 5.02 (Min 0.23 - Max 23.90) (µg/m³)
Ammonia (Annual Mean) (4 locations)	Avg 13.69 (Min 12.24 - Max 20.09) (µg/m³)
Hydrogen Sulphide (Annual Mean) (4 locations)	Avg <0.11 (Min <0.11 (LOD) - Max <0.11 (LOD)) (µg/m³)

* Average, minimum and maximum values from 4 individual monitoring locations are shown. Monitoring was performed for the month of January 2024. All analysis was performed in a UKAS certified laboratory for such analytes.

Fieldwork commissioned in October/November 2024 consisted of the following elements:

- Site Terrain
- Current Site Odour (Sniff Test according to AG5 EPA Assessment – not used as input as per AG4 guidelines, for evaluation and information purposes only)
- Site receptors

Please refer to **Appendix 9.2 and 9.3** for details of monitoring locations and a further breakdown of monitoring data collected from onsite monitoring.

9.3.4 Impact Assessment Methodology

This section describes criteria applied to the assessment of air quality and odour receptors.

Methodology for Assessing Ambient Air Impacts from Process Emissions

AERMOD is an USEPA model which relies on steady-state Gaussian plume theory and is used to evaluate odour and pollutant concentrations linked to industrial emissions. AERMOD is a step up from the Industrial Source Complex-Short Term 3 (ISCST3) model which has been extensively utilised for industrial emissions. Simulation of dispersion in the boundary layer has been improved significantly with AERMOD resulting in a more exact representation of real-world scenarios and therefore increase the precision of the model with respect to maximum ambient concentrations.

EPA Guidance document "Air Dispersion Modelling from Industrial Installations Guidance Note 2020 (AG4)" recommends AERMOD as an applicable model for gauging the impact of odour and air industrial emissions. The dispersion modelling project comprised of the below steps:

- Evaluation of applicable emission data and other related material to run the modelling software.
- Review of background/baseline sulphur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO) etc. concentrations.
- Running the air dispersion model with regard to odour and specified pollutants under maximum/worst case emission setting.
- Reporting of modelled ground level concentrations.
- Review of the impact of the modelled concentrations with respect to relevant air quality limit values

The modelling project has been undertaken using biomethane/natural gas as a fuel source for the CHP and boiler. These have been inputted within the model to operate at maximum concentrations and volumetric flow rates. The abatement stack emission point regarding odour is also based on maximum concentrations and volumetric flow rates. It was also assumed within the model that the CHP, biomethane boiler and odour abatement stack emission points in the plant would be operating 24 hrs per day, 365 days per year.

The model created was used to evaluate concentrations of carbon monoxide (CO), nitrogen oxides (as NO_2) and odour outside the site boundary and how this may affect air quality at various receptor locations.

Model input data relied on details with respect to the physical environment (i.e. terrain, buildings etc.), design details of all industrial emission points situated on site and meteorological data. The model was then able to project odour and ambient air pollutants outside the limits of the site boundary. As this model adopted a robust approach where input parameters have been overestimated (as per AG4 guidance), this will lead to an over-approximation of actual ambient air levels that will occur.

AERMOD Dispersion Modelling Data

The inputs for the dispersion modelling assessment are described in detail in this Section. The site layout, including the nearest residential properties, is shown in **Appendix 9.2**.

AERMOD Dispersion Modelling Package Description

The AMS/EPA Regulatory Model (AERMOD) is the current US EPA regulatory model used to predict pollutant concentrations from a wide range of sources that are present at typical industrial facilities.

The model accepts hourly meteorological data to define the conditions for plume rise, transport, diffusion and deposition. It estimates the concentration or deposition value for each source and receptor combination for each hour of input meteorology and calculates user-selected short term averages. The model also takes into account the local terrain surrounding the facility. Since most air quality standards are stipulated as averages or percentiles, AERMOD allows further analysis of the results for comparison purposes.

Percentile analysis for emissions is calculated for the maximum averages using the AERMOD-percent post-processing utility. This utility calculates the maximum concentration of a pollutant from all receptors at a specific percentile, for a specific period. Employing the percentile facilitates the omission of unusual short-term meteorological events that may cause elevated pollutant concentrations and hence a more accurate representation of the likely average pollutant concentrations over an averaging period.

The following information was input into the model for the prediction of maximum ground level ambient pollutant concentrations from the proposed renewable facility.

Input Parameters

The site layout map, building plans and elevations were used as a template for all sources, relevant structures and the boundary of the facility. Below are general details of the proposed facility.

Odour Emissions

The main source of emissions from the proposed site have been confirmed as:

- Feedstock Reception Hall
- Digestate Treatment Building
- Pre-Pit Tanks
- Pasteurisation Tanks

It has also been confirmed that the emissions from each of these potential sources will pass through a proposed Odour Treatment System. The total odour emissions from the Odour Treatment System are based on the maximum odour concentration from the system, as well as the total volume of air passing through the system, as summarised below:

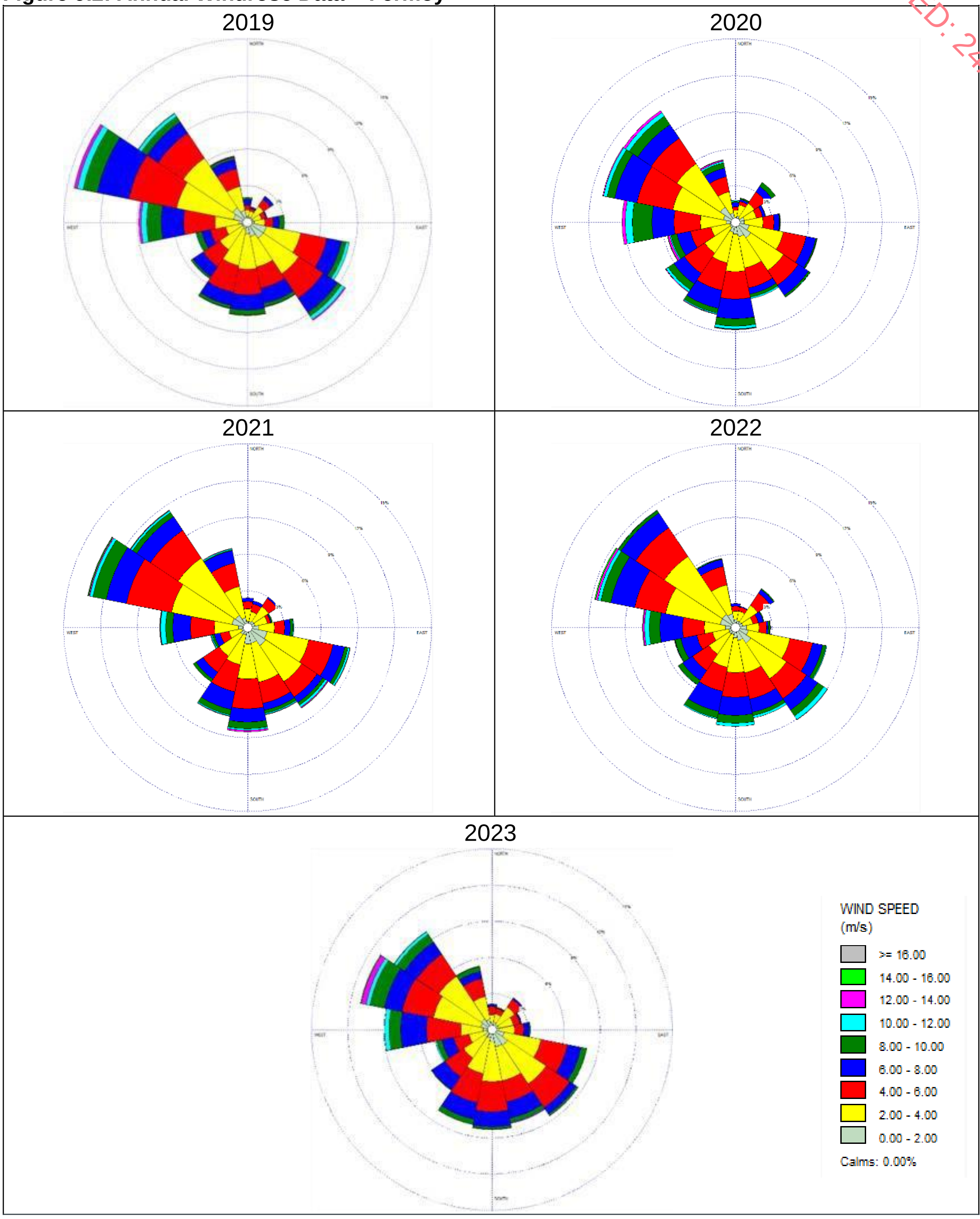
- The maximum odour concentration from the Odour Treatment System is 1,000ou/m^3.
- The Reception Hall has a volume of approx. 17,200m^3 and the Digestate Treatment Building has a volume of approx. 13,000m^3, which corresponds to a total volume of 30,200m^3.
- The ventilation and Odour Treatment System will be designed to achieve a minimum 2no. air changes per hour which corresponds to a flowrate of 61,000m^3/hour, providing adequate air changes in accordance with BAT.
- The Odour Treatment System will be designed to treat 61,000m^3/hour providing an odour destruction efficiency of 95-99.5%.

<u>Meteorological Data</u>

Five years of hourly sequential meteorological data was used for the AERMOD dispersion modelling assessment.

The closest weather station to the site can be identified on Figure 6.1 of the EPA's AG4 Guidance Note as Fermoy (Moore Park), which has an annual mean wind speed of 3.0m/s. Fermoy has been deemed representative of the average wind in the vicinity of the site, which allowed for the determination of the predicted overall average impact of emissions from the facility. The windrose data for each individual year is presented in **Figure 9.2** overleaf.

Figure 9.2: Annual Windrose Data – Fermoy



Building Downwash

When one or more buildings in the vicinity of a point source interrupts wind flow, an area of turbulence known as a building wake is created. Pollutants emitted from a relatively low level can be caught in this turbulence, affecting their dispersion. This phenomenon is called building downwash. In order to conduct an analysis of downwash effects of the point sources created to mimic the release of air from the facility, the dimensions/ heights of the proposed buildings on-site were obtained from drawings.

Digital Terrain Data

AERMOD contains a terrain data pre-processor called AERMAP. Receptor and source elevation data from AERMAP output is formatted for direct insertion into an AERMOD control file. The elevation data are used by AERMOD when calculating air pollutant concentrations.

Regulatory dispersion models applicable for simple to complex terrain situations require information about the surrounding terrain. With the assumption that terrain will affect air quality concentrations at individual receptors, AERMAP first determines the base elevation at each receptor and source. For complex terrain situations, AERMOD captures the essential physics of dispersion in complex terrain and therefore needs elevation data that convey the features of the surrounding terrain. In response to this need, AERMAP searches for the terrain height and location that has the greatest influence on dispersion for each individual receptor. This height is then referred to as the hill height scale. Both the base elevation and hill height scale data are produced by AERMAP as a file or files which can be directly inserted into an AERMOD input control file.

A baseline survey was completed at the proposed site location for selected priority pollutants, the current impact of pollutants from other sources in the vicinity of the planned site have therefore been evaluated as part of this input data (i.e. any other emission source facilities in the locality). To remain as robust and conservative as possible the CHP and odour abatement stack were assumed to be in constant operation, in reality there will need to be down time for maintenance, which could be 5 - 7% of the operating year. The CHP, biomethane boiler and odour abatement stack emissions are considered the worst-case results as the flare will only operate for a short duration throughout the full year and will never operate simultaneously.

Process Emissions Data

AERMOD has been utilised to evaluate the air quality impact from the planned odour abatement emission source and also from the two combustion sources positioned onsite i.e. the CHP and biomethane boiler.

There is also the possibility of emissions to air being generated from the planned gas upgrading plant, planned pressure relief valves (PRV), digestor vents at the site however, due to the nature and / or the infrequent use of these emission sources air dispersion modelling was not required to evaluate the possible impact from these sources. Digestor vents contain air only and used to control the pressure within the gas dome. There is no release of biogas through the digestor air vents. Pressure relief valves are not intended for routine use onsite. The PRV are only used in the event of all other gas outlets being simultaneously out of service.

The Biogas Upgrading Unit, CO_2 Liqueufactor and Grid Injection Unit (GIU) have been scoped out of the air dispersion modelling as they are designed to be gas tight with no risk of emissions.

The total odour from the Odour Treatment System is detailed in the Table below.

Table 9.4: Odour Emission Rate from Odour Treatment System

Stack	Odour Concentration (ou/m³)	Total Volume (m³/hour)	Total Volume (m³/second)	Total Odour Emission Rate (ou/s)
Odour Treatment System	1,000	61,000	16.94	**16,944**

It can be seen from the table above that the total odour emission rate from the Odour Treatment System is 16,944ou/s, which has been included as part of the odour model.

Pollutant Emissions

The two main identified sources of atmospheric emissions are the 2no. CHPs and gas boiler proposed on site.

Table 1.5 details the normalised volume flow (Nm^3/s) for each of the emission points associated with the proposed site.

Table 1.5: Normalised Flow Rates from Stacks

Stack	Actual Volume Flow (m^3/hr)	Normalised Volume Flow (Nm^3/hr)*	Normalised Volume Flow (Nm^3/s)
CHP 1 & 2	7,756	4,675	1.30
Boiler	365	260	0.07

**Normalised volume flow of both stacks is based on 273.15K, 101.3kPa and 5% 0_2*

The suppliers have provided information which details the expected level of pollutants from the identified sources.

Table 9.6: Expected Emission Levels

Pollutant	Unit	CHP	Boiler
Oxides of Nitrogen (NO_x)	mg/Nm^3	250	93
Carbon Monoxide (CO)	mg/Nm^3	1,000	N/A

Table 7 relates to the emission concentrations values through the flues associated with the CHP unit and gas boiler on the proposed site, based on the expected emission levels detailed in the Table above.

Table 9.7: Emission Concentrations

Pollutant	CHP Emission Concentration Values (mg/Nm^3)	Boiler Emission Concentration Values (mg/Nm^3)	Stack Emissions (g/s)	
			CHP Engine (1.30 Nm^3/s)	Boiler (0.07 Nm^3/s)
Oxides of Nitrogen (NOx)	250	93	**0.325**	**0.007**
Carbon Monoxide (CO)	1,000	N/A	**1.30**	**N/A**

In line with EPA AG4 Guidance, further assessment of the site has been undertaken to account for the stack emissions operating at 75%, rather than at a maximum which is reflected above. This additional assessment is included in **Appendix 9.5**.

Detailed dispersion modelling was carried out for NO_2 and CO. SO_2 has not been modelled for these sources as it has been shown that there is no sulphur content in the fuel of natural gas which is structurally identical to biomethane. The emissions for SO_2 using these systems are therefore negligible (Department for Energy Security and Net Zero and Department for Business, Energy & Industrial Strategy, UK. 2021: Combined Heat and Power – Environmental A detailed guide for CHP developers – Part 3).

Table 9.8: Sources scoped in/out of modelling

Potential Source	Modelled	Justification
CHPs	Yes	Will be emitting to air
Boiler	Yes	Will be emitting to air
Odour Abatement	Yes	Will be emitting to air
Biogas Upgrading Unit	No	Designed to be gas tight – no risk of emissions
CO_2 Liqueufactor	No	Designed to be gas tight – no risk of emissions
Grid Injection Unit (GIU)	No	Designed to be gas tight – no risk of emissions

Stack Emission

Table9 below shows the ventilation rates of the stacks relied upon in the assessment.

Table 9.9: Ventilation Rates from Odour & Pollutant Emission Stacks

Parameter	Odour Treatment System	CHP 1	CHP 2	Boiler
X – coordinate	148807	148877	148880	148883
Y – coordinate	131799	131656	131656	131661
Stack Height (m)	11	6	6	5.6
Stack tip diameter (m)	1.2	0.3	0.3	0.2
Actual Volume Flow (m^3/hr)	61,000	7,756	7,756	365
Flue Gas Temp (K)	283	453	453	383
Efflux Velocity (m/s)	14.99	30.49	30.49	3.23

Potential and Fugitive Emission Points

The usage of the emergency flare is envisaged to be infrequent and would operate for approximately 6% operating time/annum. The existence of 1 no. gas flare is for times when the gas injection unit is not in operation, when the storage of gas has reached maximum capacity and when the CNG compression unit requires maintenance. Both Compressor and GIU would need to be down at the same time. The flare will have a capacity of 110% of the estimated maximum hourly biogas produced and will safeguard the secure and complete combustion of biogas where necessary. Flaring of gas is an infrequent occurrence and will only take place as a final option during a period of irregular operation i.e., during maintenance or breakdown.

Operational Traffic Emissions

LA105 DMRB guidance gives details for assessing significance of air quality effects of a development in relation to nitrogen dioxide (NO_2) and particulate matter (PM_{10}). The table below describes the corresponding terms used to describe the level of significance from the DMRB in conjunction with EPA EIAR guidance.

Table 9.10 Traffic air quality effects (Operational Stage)

Magnitude of change in annual mean NO_2 or PM_{10} (µg/m^3)	Magnitude (DMRB)	Significance (EPA)
>4 (>10%)	Large	Significant, Very Significant, Profound
>2 (>5%)	Medium	Moderate
>0.4 (>1%)	Small	Slight
0.4 (<1%)	Negligible	Not significant, Imperceptible

Traffic input data is included in **Appendix 9.3**. The DMRB Screening Method spreadsheet was used to forecast pollution concentrations at a receptor position. A robust and conservative approach was utilized when assuming background concentrations (i.e. 12.4 µg/m3 for NO2 and 11.2 µg/m3 for PM10 – highest values taken from **Table 9.12** locations below). **Table 9.11** (shown below) shows the results of "Do Minimum" (DM) and "Do Something" (DS) scenarios for 2025 assuming (as a worst-case scenario), receptors are 5m away from road links.

Table 9.11 Projected NO_2 and PM_{10} traffic concentrations

Receptor	NO_2				PM_{10}			
	DM (µg/m3)	DS (µg/m3)	Change (µg/m3)	Magnitude	DM (µg/m3)	DS (µg/m3)	Change (µg/m3)	Magnitude
R1	26.0	27.3	1.3	Negligible	38.40	38.70	0.30	Negligible

9.4 Description of the Receiving Environment

9.4.1 Background

This section of the chapter provides the baseline information in relation to air quality and odour that exists in the vicinity of the Proposed Development. The subject site occupies a total area of *ca.* 5.29 ha and is situated in the townland of Cappanihane, Bruree, Co. Limerick. The site is approximately 13km west of Kilmallock, Co. Limerick, 20km east of Newcastle West, Co. Limerick and 25km southwest of Limerick City. The approximate grid reference location for the centre of the site is R 48890 31642, ITM: 548844, 631675.

Figure 9.3 Proposed site development boundary

Air quality monitoring programs are routinely undertaken by the EPA and Local Authorities. The most recent annual report on air quality "Air Quality in Ireland Report 2022" (EPA 2023), details the range and scope of monitoring undertaken throughout Ireland. As part of the implementation of the Framework Directive on Air Quality (1996/62/EC), four air quality zones have been defined in Ireland for air quality management and assessment purposes (EPA 2021), see **Figure 9.4** below. 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, the location of the Proposed Development is categorised as Zone D (EPA 2021). The development site was assessed as Zone D.

The typical baseline air quality data outlined below in **Table 9.12** is based on a review of the Air Quality Monitoring Report 2022 (EPA, 2023).

Table 9.12: Typical Air Quality Monitoring Data Representative of EPA Zone D Monitoring Sites

Pollutant	Zone D Monitoring Stations	EPA Baseline Monitoring Data Annual Mean 2022 (μg/m^3)	Average (μg/m^3)	Relevant Limit Value
NO_2	Emo Court	3.3	7.3	NO_2 annual mean limit for the protection of human health = 40 μg/m^3
	Birr	12.4		
	Castlebar	7.5		
	Carrick-on-Shannon	11.5		

	Kilkitt	2		
	Edenderry	7.3		
NO_X	Emo Court	4.6	14.0	NO_x annual mean limit for the protection of human health = 30 µg/m^3
	Birr	29.8		
	Castlebar	11.4		
	Carrick-on-Shannon	23.7		
	Kilkitt	2.6		
	Edenderry	11.8		
CO	Birr	0.3	0.3	CO maximum daily 8–hour mean value = 10 mg/m^3
PM_{10}	Castlebar	11.2	9.3	PM_{10} annual mean limit for the protection of human health = 40 µg/m^3
	Kilkitt	8.5		
	Claremorris	7.9		
	Askeaton	9.4		

It can be seen from the Table above that the annual mean concentrations for all pollutants are below the relevant limit values for the protection of human health.

The background concentrations utilised within this assessment represent an average of the above values.

As per AG4 guidance monitoring of background odours is inappropriate and cannot be added to modelled odour concentrations.

In summary, existing baseline levels of the pollutants based on extensive long-term data from the EPA are below ambient air quality limit values in the vicinity of the Proposed Development. This indicates there is a relatively good level of air quality in the area of the Proposed Development.

9.4.2 Climate and Regional Air Quality

Applicable Agreements and Emissions Ceilings

Ireland ratified the Gothenburg Protocol at the 1979 UN Convention on Long Range Transboundary Air Pollution. The European Union directive on ambient air quality assessment and management came into effect in September 1996 96/62/EC and describes the policy framework for 12 air pollutants identified to have harmful effects on human health and the environment. Air quality limit levels (i.e. ambient pollutant concentrations not to be breached), for the pollutants are described through a series of daughter directives. The first daughter directive, 1990/30/EC, sets limit values for NO2, amongst other pollutants, in ambient air. Following the daughter directives, EU council directive 2008/50/EC came into effect in June 2008, combining the existing air quality legislation. Directive 2008/50/EC was transposed into Irish national legislation in 2011 through the Air Quality Standards Regulations 2011. The directive consolidated the four daughter directives and one council decision into a single directive on air quality. The new directive also introduced a new limit value for fine particulate matter, $PM_{2.5}$, but does not alter the existing air quality standards.

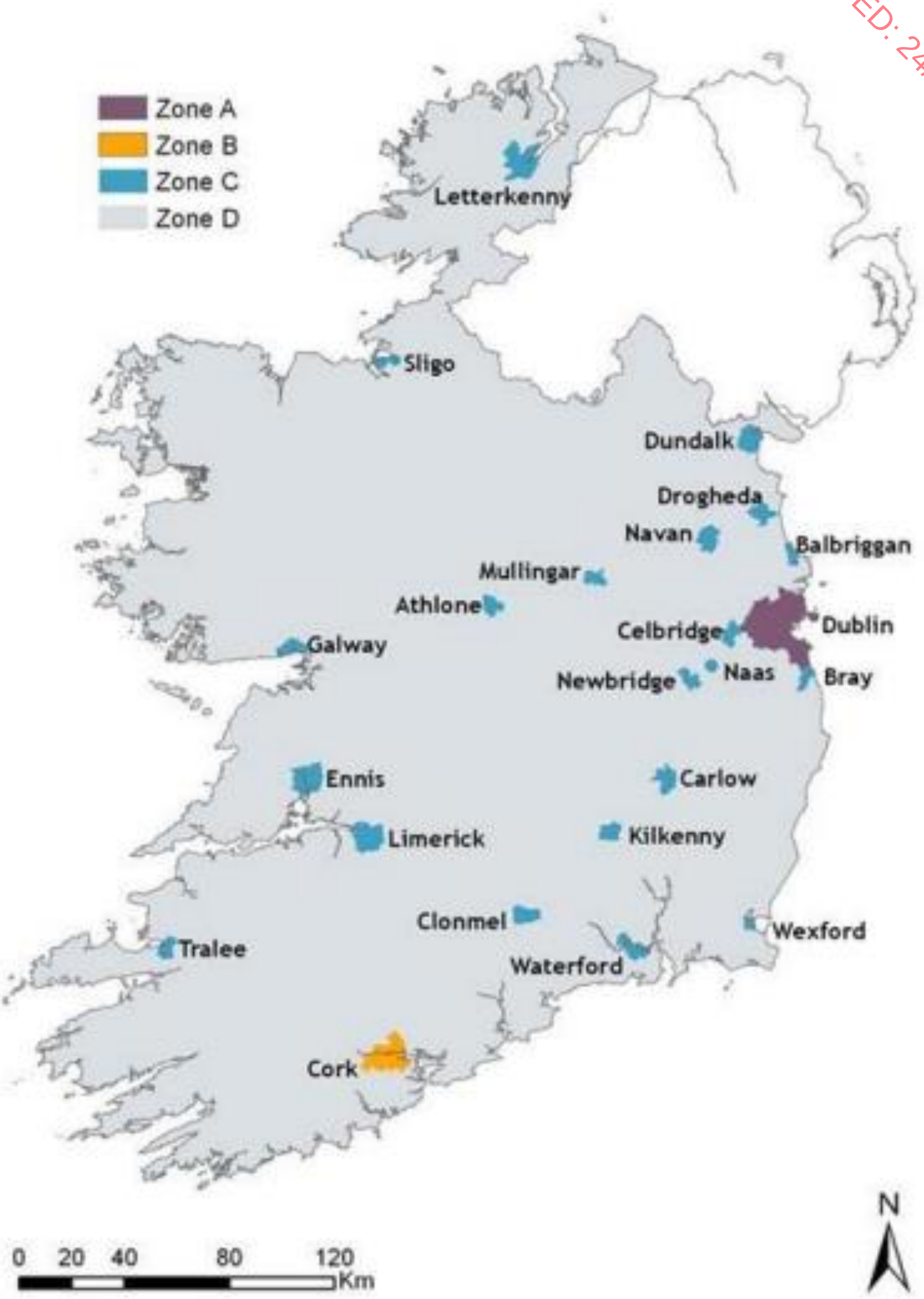
National emission reduction obligations defined targets for the main air pollutants to be attained in 2020 and into the future and to also contain emission reduction obligations for PM2.5. In relation to Ireland, 2020 emission targets are 25 kt for SO2 (65% below 2005 levels), 65 kt for NOX (49% reduction), 43 kt for VOCs (25% reduction), 108 kt for NH3 (1% reduction) and 10 kt for PM2.5 (18% reduction). The National Emissions Ceiling Directive (NECD - European Commission Directive 2001/81/EC) also proposed the same limit values as the Gothenburg Protocol (1999).

On a national level, the Air Pollution Act (1987) is the main legislation concerning air quality in Ireland and defines the process by which local authorities can take steps which are deemed necessary to manage air pollution appropriately.

As described above, the Air Quality Standards Regulations transpose Directive 2008/50/EC into Irish law. Limit values for various pollutants in ambient air are described in these regulations. With regard to this project/development the ambient background pollutant levels deemed applicable for human health and the environment in terms of annual mean are described in **Table 9.1 and 9.2.**

Figure 9.4 overleaf illustrates the 4 air quality zones that have been established in Ireland for evaluation and management purposes. Dublin is categorized as Zone A and Cork as Zone B. Zone C consists of 23 towns with a population of greater than 15,000. The remainder of the country, which denotes rural Ireland but also includes all towns with a population of less than 15,000, is defined as Zone D. The development site lies within Zone D.

Figure 9.4: Air Framework Directive Zones (EPA, Air Quality in Ireland Report 2016)



Climate Agreements

Ireland ratified the United Nations Framework Convention on Climate Change in April 1994 and the Kyoto Protocol in principle in 1997 and formally in May 2002. For the purposes of the European Union burden sharing agreement under Article 4 of the Kyoto Protocol, in June

1998, Ireland agreed to limit the net growth of the six Greenhouse Gases under the Kyoto Protocol to 13% above the 1990 level over the period 2008 to 2012.

The UNFCCC is continuing detailed negotiations in relation to GHGs reductions and in relation to technical issues such as Emission Trading and burden sharing. The most recent Conference of the Parties to the Convention (COP29) took place in Baku from the 11th November to the 22nd November 2024 and focussed on accelerating the implementation of the Paris Agreement having shown progress was too slow. The Paris Agreement was established at COP21 in Paris in 2015 and is an important milestone in terms of international climate change agreements. The “Paris Agreement”, agreed by 200 nations, has a stated aim of limiting global temperature increases to no more than 2°C above pre-industrial levels with efforts to limit this rise to 1.5°C. The aim is to limit global GHG emissions to 40 gigatonnes as soon as possible whilst acknowledging that peaking of GHG emissions will take longer for developing countries. Contributions to greenhouse gas emissions will be based on Intended Nationally Determined Contributions (INDCs) which will form the foundation for climate action post 2020.

The EU, on the 23rd/24th of October 2014, agreed the “2030 Climate and Energy Policy Framework”. The European Council endorsed a binding EU target of at least a 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990. The target will be delivered collectively by the EU in the most cost-effective manner possible, with the reductions in the Emission Trading Scheme (ETS) and non-ETS sectors amounting to 43% and 30% by 2030 compared to 2005, respectively. Secondly, it was agreed that all Member States will participate in this effort, balancing considerations of fairness and solidarity. The policy also outlines, under “Renewables and Energy Efficiency”, an EU binding target of at least 27% for the share of renewable energy consumed in the EU in 2030.

The Climate Action and Low Carbon Development Act 2015 identifies plans to be drafted and accepted by the Government in relation to climate change for the purpose of a transition to a low carbon, climate resilient and environmentally sustainable economy. The act required the establishment of the Climate Change Advisory Council and the establishment and approval by the government of a National Mitigation Plan (to be published every five years), National Adaptation Framework and an Annual Transition Statement. The first National Mitigation Plan for Ireland was published in July 2017 and defines the central roles of the key Ministers accountable for the sectors covered by the Plan – Electricity Generation, the Built Environment, Transport and Agriculture. This first Plan defines the initial foundations to be implemented to transition Ireland to a low carbon, climate resilient and environmentally sustainable economy by 2050. The Plan also includes over 100 individual actions for various Ministers and public bodies to take forward.

In addition to the publication of the National Mitigation Plan (DCCAE, 2017), the government also publishes a Climate Action Plan, i.e. Climate Action Plan 2024 (Government of Ireland, 2024).

The Climate Action Plan outlines the current status across key sectors including Electricity, Transport, Built Environment, Industry and Agriculture and outlines the various broadscale measures required for each sector to achieve ambitious decarbonisation targets. The Climate Action Plan also details the required governance arrangements for implementation including an increased level of involvement from local government.

The national policy position for Climate Change establishes a vision for Ireland of low-carbon by 2050 (80% reduction on 1990 emissions) across the electricity generation, built environment and transport sectors; and in parallel, an approach to carbon neutrality in the agriculture and land use sectors, including forestry.

Regional Policy Objectives

A review of the Limerick County Development Plan (2022 – 2028) was carried out to determine the policies and objectives relevant to climate action throughout the region. It is noted in the vision of the plan that sustainable development through a proactive approach will be taken by the Council that will:

- Ensure the sustainable use of natural resources.
- Enables us to live within the area's environmental capacity.
- Enables and enhances our resilience to climate change.

Applicable policy objectives in relation to climate are found below.

Climate Change Policy Objectives Applicable:

CAF O8 – It is an objective of the Council to promote and support development of renewable energy sources, which will achieve low carbon outputs including on-land and offshore renewable energy production, which support tidal turbine, PV, community energy companies and battery technology, subject to adequate environmental and ecological protection.

CAF P2 – It is a policy of the Council to support the transition to a low carbon climate resilient economy, by way of reducing greenhouse gases, increasing renewable energy and improving energy efficiency and will future proof policies and objectives to deliver on this approach, in so far as possible.

CAF O14 – It is an objective of the Council to support the local production of renewable energy and connection to the gas network. Where electricity is being generated locally, the Council will support the provision of infrastructure for its transmission to the grid, subject to it fulfilling technical and environmental requirements.

CAF O15 – It is an objective of the Council to encourage the adoption of the circular economy through the promotion of the reuse, recycling and reduction of the use of raw materials and resources.

CAF P6 – It is a policy of the Council to support renewable energy commitments outlined in national and regional policy, by facilitating the development and exploitation of a range of renewable energy sources at suitable locations throughout Limerick, where such development does not have a negative impact on the surrounding environment landscape, biodiversity, water quality or local amenities, to ensure the long-term sustainable growth of Limerick.

CAF P9 – It is a policy of the Council to consider all emerging renewable energy technologies, such as hydrogen electrolysis, pumped storage and small-scale anaerobic digestion and any other source of renewable energy technologies that are viable as a means of energy security, subject to the relevant level of necessary environmental and ecological assessments.

CAF O26 – It is an objective of the Council to support the development of bio energy and projects in suitable locations and subject to adequate assessment. The development of grid injection, where this is necessary for renewable energy input will also be supported.

CAF O27 – It is an objective of the Council to encourage and facilitate the production of energy from renewable sources, such as from bioenergy, solar, hydro, tidal, geothermal and wind energy, subject to appropriate levels of environmental assessment and planning considerations.

9.4.3 Future Climate Conditions

An EPA report, High-resolution Climate Projections for Ireland – A Multimodel Ensemble Approach, Report No. 339 details projected future baseline conditions. The report indicates that mid-century mean annual temperatures are predicted to rise by 1.3 – 1.6°C under worse case scenarios and incidences of heatwaves are expected to rise by the middle of the century. The coldest 5% of daily minimum temperatures are projected to rise by 1–2.4°C. Incidences of intense precipitation occurrences are predicted to increase over the year as a whole and in the winter and autumn months, with "likely" predicted increases of 5–19%. The number of extended dry periods (defined as at least 5 consecutive days for which the daily precipitation is less than 1mm) is also projected to increase substantially by the middle of the century over the full year and for all seasons except spring. The projected increases in dry periods are largest for summer.

9.4.4 Methodology for Assessing Impacts on Climate and Regional Air Quality

The quantity of carbon emitted from natural cycles through the earth's atmosphere, waters, soils and biota is much greater than the quantity added by anthropogenic GHG sources. However, the focus of bodies such as the UNFCCC and the IPCC is on anthropogenic emissions because it is these emissions that have the potential to alter the climate by disrupting the natural balances in carbon's biogeochemical cycle and altering the atmosphere's heat-trapping ability.

Construction Phase

Construction traffic and embodied energy of construction materials are likely to be a possible cause of greenhouse gas emissions because of construction related to the Proposed Development. Construction plant and machinery will lead to CO_2 and NO_2 emissions during construction of the planned development. Due to the period, nature and scale of construction, CO_2 and NO_2 emissions from construction plant, machinery and embodied energy of construction resources will have a short-term and imperceptible impact on climate.

Operational Phase

Ireland's (EU - Effort Sharing Regulation) ESR emissions annual limit for 2023 is 40.52 Mt CO2eq. Ireland's provisional 2022 greenhouse gas ESR emissions are 42.79 Mt CO2eq, this is 2.27 Mt CO2eq more than the annual limit for 2023. This value is the national total emissions less emissions generated by stationary combustion and aviation operators that are within the EU's emissions trading scheme. This indicates that Ireland is not in compliance with its 2023 Effort Sharing Regulation annual limit, exceeding the allocation by 0.36 Mt CO2eq after using the ETS flexibility. Agriculture and Transport accounted for 76% of total ESR emissions in 2023.

Biomethane production and use as a fuel is considered CO_2 neutral and therefore does not add GHGs to the atmosphere if efficiently recovered and combusted for heat and/or electricity usage as it replaces the requirement for fossil fuels. The CO_2 component of biomethane is also considered carbon neutral, as the feedstock whether grass or animal waste has drawn the CO_2 from the atmosphere. This contrasts with conventional fossil fuel gases, which release additional CO_2 into the atmosphere from existing carbon sinks. It is also important to note that biomethane can be injected directly into existing gas networks, displacing the need for natural gas.

Given that approximately half of the feedstock for the Proposed Development will be animal waste such as manures and slurries, the methane from this feedstock will be captured, optimized, and utilized instead of being released into the atmosphere during traditional land spreading. The EU commissioned study (Biosurf, 2016) on the GHG emissions related to different methods of producing biomethane from different feedstocks was considered. This study was compared with various common scenarios. One of the scenarios studied compared the production of biogas from the biodegradable fraction of Municipal Solid Waste with landfilling of that same feedstock. This gives us indicative values only as animal manures would not be disposed to landfill. It found that a saving of 3.377 tonnes CO_2eq per ton of feedstock were made compared with landfilling. This included the emissions saved compared with the burning of virgin gas, on-site energy production, any emissions from the process and spreading of digestate as well as emissions avoided by diverting the feedstock from landfill. Given that the Proposed Development will use up to 90,000 tonnes of biodegradable feedstock per year there is a potential GHG emissions saving of 303,930 tonnes of CO_2eq. This equates to approximately 0.5% of Ireland's 60.76 million tonnes CO_2eq GHG emissions in 2022 (1990-2022 EPA Inventory data (updated June 2023).

Due to the production of *ca.* 510-580 Nm^3 of biomethane per hour which will be exported and used as an alternative fuel to fossil fuels for regional energy and heat production, the net effect of the Proposed Development during the operational phase will be a slight, positive, long-term impact on climate and regional air quality. The (Gas Network Ireland) GNI predict that by achieving a net zero carbon gas network by 2050, at least 18.7 Mt per annum of CO_2 emissions would be saved which equates to circa 31% of Ireland's current emissions.

The Proposed Development will therefore have a slight positive impact on Ireland's greenhouse gas emissions in line with the Climate Action Plan (Government of Ireland, 2024) and therefore the climate. The SEAI estimates that carbon savings of 0.7 Mt CO_2 equivalent per annum by 2030 could be achieved through the displacement of fossil fuels with biomethane however this will only be achievable if developments such as the Proposed Development are constructed.

9.5 Likely Significant Effects

The assessment focuses on predicted effects in relation to air quality and climate. The assessment relates to effects occurring during both the construction and operational phases of the development.

9.5.1 Do-Nothing Scenario

The Do-Nothing scenario relates to the preservation of the current site with no planned development occurring. In this situation, air quality will continue as per the baseline levels described in **Section 9.4.1** and will alter with respect to changes in the local and wider area (this includes but is not limited to: affects from new potential developments, road layout / traffic patterns, upgrades/developments to vehicle technology etc.).

9.5.2 Receptor Sensitivity

Construction

Regarding the construction stage of the planned development the most likely effect on air quality will be from construction dust emissions (nuisance dust and PM_{10}/$PM_{2.5}$ emissions) associated with activities such as excavations, infilling materials, stock piling and movement of vehicles.

The Proposed Development is deemed large in scale and nature and is classified as such with respect to "Potential for Construction Dust Effects (TII, 2011)" therefore there is the potential for significant dust soiling 100m from the construction source (TII 2011) (**Table 9.13**).

Construction dust usually deposits within 200m of a construction area; however the bulk of this deposition will occur within the first 50m. There are no sensitive receptors (residential receptors) within 50m of the site. Therefore, the surrounding area can be classified as low risk with respect to construction dust effect in this regard. Emission effects from planned construction are finite and short-term, mitigation measures (outlined in **Section 9.6**) will also be in place through this stage, leading to air quality effects that will temporary, negligible and short-range.

Table 9.13: Potential for Construction Dust Effects (TII, 2011)

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

IAQM (2024) conditions described in **Appendix 9.1** were also considered, these detail how the estimation of dust emission magnitudes (prior to mitigation) for earthworks, construction and track out actions which are shown in **Table 9.14** were completed.

Table 9.14 Summary of Dust Emissions Magnitudes (Before Mitigation).

Activity	IAQM Criteria	Dust Emission Magnitude
Earthworks	Total site area where earthworks may occur is >10,000m^2 Undeveloped land –soil type may include potentially dusty soil The number of heavy earth moving vehicles active at any one time is estimated to be approximately 5-10 The height of bunds on site will be 4-8m The total material to be moved is estimated to be >20,000 tonnes Earthworks may occur in both wet and dry months.	Large
Construction	Total building volume will approximately be <31,000m^3. Construction materials are expected to be potentially dusty. On-site concrete batching is not expected to be proposed.	Medium

Activity	IAQM Criteria	Dust Emission Magnitude
Trackout	Number of heavy vehicles per day out of the site is estimated to be 10-50 Vehicle may travel on unpaved roads 50-100m The surface type of the site has the potential to be dusty	Large

According to IAQM construction dust guidance the following factors are considered with regard to sensitivity of an area:

- The specific sensitivities of receptors in the area;
- The proximity and number of those receptors;
- In the case of PM_{10}, the local background concentration; and
- Site-specific factors, such as whether there are natural shelters, such as trees, to reduce the risk of wind-blown dust.

Human and ecological receptors are assessed against the potential effect from the associated construction of the development and HGV routes which could generate trackout. It is expected that site traffic will access/egress the site via L8658 to the west of the site.

Table 9.15 describes the established sensitivity of the locality with the factors specified that guided the assessment (please refer to **Appendix 9.1** for more information). Construction activities are applicable up to 250m from the planned development site boundary, however trackout actions are only deemed applicable 50m from the periphery of the route, in accordance with IAQM construction dust guidance. Online NPWS (National Parks and Wildlife Services) databases were used to locate sensitive ecological receptors in the vicinity of the planned development. Human receptors were determined by referring to online satellite imagery (see **Figure 9.2**).

Table 9.15 Sensitivity of the area

Potential Effect		Sensitivity of the surrounding area		
		Earthworks	Construction	Trackout
Dust soiling	Receptor sensitivity	High	High	High
	Number of receptors	1-10	1-10	1-10
	Distance from the source	<250m	<250m	<250m
	Overall Sensitivity of the Area	**Low**	**Low**	**Low**
Human health	Receptor sensitivity	High	High	High
	Number of receptors	1-10	1-10	1-10
	Distance from the source	<250m	<250m	<250m
	Overall Sensitivity of the Area	**Low**	**Low**	**Low**
Ecological	Receptor sensitivity	**NA**		

According to the National Parks and Wildlife Services website (https://www.npws.ie/) there are no ecologically designated sites (Special Protection Areas, Special Areas of Conservation or Natural Heritage Areas) within 50m of the site boundary or potential routes along which track out could arise.

Construction - Risk of Effects

The dust emission magnitude described in **Table 9.14** has been merged with the sensitivity of the area in **Table 9.15** to establish the risk of effects of construction activities before mitigation. These have been assessed considering risk categories of each activity in **Appendix 9.1**.

Dust risk effects from construction activities are classified as low risk, as is shown in **Table 9.16**. Mitigation measures to decrease construction phase effects are defined based on this assessment in **Section 9.6**.

Table 9.16 Summary of Dust Risk from Construction Activities

Potential Impact	Dust Risk Impact		
	Earthworks	Construction	Trackout
Dust soiling	Low risk	Low risk	Low risk
Human health	Low risk	Low risk	Low risk

Operational

Sensitive receptors within 1km of Proposed Development and its access road were selected for inclusion within the odour and air dispersion modelling assessments. The sensitive receptors modelled represent residential and amenity (i.e. schools, churches etc.) within the vicinity of the Proposed Development and were chosen due to their proximity to the Proposed Development. Designated sites up to 15km away were also considered within the evaluation, the model extents were that of a 1km radius for residential and community receptors and 15km radius for designated sites - therefore any points beyond this used representative locations within the scope of the model.

Details of the receptor locations are provided in **Table 9.17, 9.18** and **9.19**. In addition to predicting the worst-case impact beyond the site boundary, the predicted impact at the worst-case sensitive receptor will also be reported for the dispersion modelling results (see **Section 9.5.4**).

Table 9.17 Residential Sensitive Receptors within 1km of Subject Site

Receptor Identity	Receptor Description	X Coordinate (m) UTM	Y Coordinate (m) UTM	Direction from application area	Approx. distance from site boundary (m)
R1	Residential Property	548806	631520	S	16
R2	Residential Property	548800	631148	S	388
R3	Residential Property	548974	630648	S	895
R4	Residential Property	549619	630999	SE	915
R5	Residential Property	549657	631019	SE	932
R6	Residential Property	549085	631505	SE	186
R7	Residential Property	549192	631511	SE	283

ORS

Receptor Identity	Receptor Description	X Coordinate (m) UTM	Y Coordinate (m) UTM	Direction from application area	Approx. distance from site boundary (m)
R8	Residential Property	549240	631505	SE	332
R9	Residential Property	549433	631610	E	501
R10	Residential Property	549416	631668	E	472
R11	Residential Property	549141	631882	NE	225
R12	Residential Property	549171	631883	NE	252
R13	Residential Property	549398	632002	NE	509
R14	Residential Property	549418	632052	NE	550
R15	Residential Property	549353	632074	NE	508
R16	Residential Property	549355	632123	NE	540
R17	Residential Property	549359	632161	NE	569
R18	Residential Property	549352	632235	NE	617
R19	Residential Property	549384	632275	NE	668
R20	Residential Property	549473	632305	NE	751
R21	Residential Property	549360	632525	NE	860
R22	Residential Property	549192	632619	NE	882
R23	Residential Property	549166	632589	NE	846
R24	Residential Property	549161	632736	NE	988
R25	Residential Property	548733	632022	N	235
R26	Residential Property	548629	632058	N	283
R27	Residential Property	548709	632226	N	438
R28	Residential Property	548665	632262	N	476
R29	Residential Property	548861	632404	N	626
R30	Residential Property	548656	632395	N	609
R31	Residential Property	548653	632458	N	672
R32	Residential Property	548695	632485	N	696
R33	Residential Property	548675	632515	N	728
R34	Residential Property	548891	632504	N	728
R35	Residential Property	548676	632549	N	762
R36	Residential Property	548045	632367	NW	884

Receptor Identity	Receptor Description	X Coordinate (m) UTM	Y Coordinate (m) UTM	Direction from application area	Approx. distance from site boundary (m)
R37	Residential Property	548065	632297	NW	824
R38	Residential Property	548039	632278	NW	833
R39	Residential Property	548220	632094	NW	579
R40	Residential Property	548219	632063	NW	565
R41	Residential Property	548229	632032	NW	541
R42	Residential Property	548228	632024	NW	539
R43	Residential Property	548262	632004	NW	500
R44	Residential Property	547934	632046	NW	820
R45	Residential Property	547815	632065	NW	939
R46	Residential Property	548433	631583	W	318
R47	Residential Property	548336	631553	W	420
R48	Residential Property	548178	631509	W	584
R49	Residential Property	548153	630817	SW	948
R50	Residential Property	548272	630834	SW	861

Table 9.18 Commercial, Education, Religious, Community Etc. Sensitive Receptors within 1km of Subject Site

Receptor Identity	Receptor Description	X Coordinate (m) UTM	Y Coordinate (m) UTM	Direction from application area	Approx. distance from centre of subject site (m)
C1	Farm Yard	549123	631135	SE	476
C2	Farm Yard	548916	630606	S	932
C3	Farm Yard	549537	630947	SE	891
C4	Farm Yard	549754	632325	NE	980
C5	Commercial	549345	632297	NE	660
C6	Farm Yard	549312	632486	NE	802
C7	Farm Yard	549150	632717	NE	967
C8	Commercial	548883	632553	N	776
C9	Farm Yard	548161	632592	NW	975
C10	Farm Yard	548078	632343	NW	843
C11	Farm Yard	547826	632026	W	918
C12	Farm Yard	548361	631586	W	388
C13	Farm Yard	548171	631472	W	599

Table 9.19 European Designated Sites within a 15 km Radius of the Subject Site

Receptor Identity	Designated Site	Citation	X Coordinate (m) UTM	Y Coordinate (m) UTM	Direction from	Approx. distance from centre

					application area	of subject site (m)
DS1	Tory Hill SAC	SAC	552916	642227	NE	11200
DS2	Blackwater River (Cork/Waterford) SAC	SAC	552230	618141	SE	13820
DS3	Lower River Shannan SAC	SAC	546849	646608	N	14950

9.5.3 Point Sources - Operational Phase

The information relating to the operational phase impacts of the Proposed Development is drawn from the operation of the AERMOD model. It is important to note that emissions are overestimated where possible in terms of input i.e. emission rates, background concentration, operating hours, location of concentrations, ambient air limit values, worst case locations, modelled years results considered etc.

9.5.4 Receptor Results

Odour

Odour modelling was carried out for each individual year with the results at the nearest sensitive locations presented in **Table 9.20** below. All results are the odour concentration in (ou_E/m^3).

Table 9.20: 98th Percentile of the Max 1-hr odour levels at nearest residential properties

Location	2019	2020	2021	2022	2023	Average
R1	0.38	0.34	0.47	0.41	0.36	0.39
R2	0.08	0.07	0.08	0.07	0.10	0.08
R3	0.04	0.04	0.05	0.03	0.04	0.04
R4	0.27	0.25	0.28	0.30	0.22	0.27
R5	0.29	0.25	0.28	0.33	0.24	0.28
R6	0.90	0.80	0.87	0.96	0.77	0.86
R7	0.87	0.77	0.89	0.92	0.80	0.85
R8	0.78	0.72	0.86	0.83	0.69	0.78
R9	0.45	0.41	0.49	0.43	0.44	0.44
R10	0.41	0.40	0.41	0.38	0.37	0.39
R11	0.59	0.54	0.47	0.53	0.59	0.54
R12	0.55	0.50	0.42	0.49	0.54	0.50
R13	0.23	0.24	0.16	0.20	0.24	0.21
R14	0.17	0.22	0.13	0.17	0.21	0.18
R15	0.19	0.24	0.13	0.20	0.23	0.20
R16	0.16	0.21	0.12	0.18	0.23	0.18
R17	0.17	0.21	0.13	0.17	0.25	0.19
R18	0.16	0.22	0.13	0.17	0.23	0.18
R19	0.14	0.21	0.12	0.15	0.20	0.17
R20	0.12	0.16	0.10	0.13	0.19	0.14
R21	0.17	0.22	0.21	0.21	0.26	0.21

ORS

Location	2019	2020	2021	2022	2023	Average
R22	0.23	0.32	0.25	0.27	0.31	0.27
R23	0.24	0.33	0.26	0.28	0.33	0.29
R24	0.22	0.25	0.18	0.20	0.28	0.23
R25	1.60	1.52	1.60	1.55	1.57	1.57
R26	1.15	1.06	1.18	1.29	1.20	1.17
R27	0.83	0.73	0.91	0.80	0.80	0.81
R28	0.79	0.68	0.77	0.70	0.70	0.73
R29	0.50	0.57	0.47	0.54	0.52	0.52
R30	0.55	0.46	0.55	0.48	0.50	0.51
R31	0.43	0.38	0.49	0.44	0.41	0.43
R32	0.44	0.37	0.47	0.40	0.42	0.42
R33	0.40	0.33	0.44	0.38	0.37	0.39
R34	0.40	0.46	0.35	0.41	0.40	0.40
R35	0.37	0.31	0.41	0.35	0.36	0.36
R36	0.34	0.32	0.31	0.31	0.35	0.33
R37	0.33	0.32	0.36	0.36	0.35	0.35
R38	0.32	0.31	0.36	0.36	0.35	0.34
R39	0.49	0.45	0.49	0.49	0.48	0.48
R40	0.52	0.45	0.53	0.42	0.45	0.47
R41	0.52	0.44	0.50	0.42	0.44	0.46
R42	0.50	0.41	0.48	0.39	0.44	0.45
R43	0.55	0.44	0.52	0.40	0.46	0.48
R44	0.25	0.15	0.25	0.14	0.16	0.19
R45	0.19	0.11	0.20	0.11	0.13	0.15
R46	0.19	0.27	0.25	0.42	0.38	0.31
R47	0.12	0.16	0.14	0.25	0.25	0.19
R48	0.07	0.09	0.08	0.13	0.14	0.10
R49	0.02	0.03	0.03	0.03	0.04	0.03
R50	0.02	0.02	0.03	0.02	0.03	0.02
R51	0.01	0.02	0.02	0.02	0.03	0.02
C1	0.24	0.19	0.23	0.20	0.25	0.22
C2	0.03	0.03	0.04	0.03	0.03	0.03
C3	0.26	0.21	0.22	0.29	0.17	0.23
C4	0.07	0.09	0.05	0.07	0.10	0.08
C5	0.16	0.26	0.15	0.18	0.23	0.20
C6	0.19	0.25	0.23	0.25	0.29	0.24
C7	0.23	0.26	0.19	0.21	0.29	0.23
C8	0.36	0.41	0.34	0.39	0.38	0.38
C9	0.27	0.24	0.28	0.31	0.28	0.28
C10	0.35	0.34	0.34	0.33	0.38	0.35
C11	0.15	0.10	0.18	0.10	0.12	0.13
C12	0.13	0.18	0.17	0.25	0.27	0.20
C13	0.06	0.09	0.08	0.14	0.14	0.10

For the proposed site layout, all approved or existing dwellings are below the $1.5ou_E/m^3$ when considered as individual years and as a 5-year average of the 98th percentile.

Odour Significance

An assessment of the significance of the odour impact at each receptor using the specified criterion within the AG5 odour guidance (see Error! Reference source not found.**9.2**) and dispersion modelling results (see **Table 9.20**) has been made in **Table 9.21** below.

Table 9.21: Significance of Estimated Odour Emissions at Considered Receptors

Receptor ID		Maximum Annual 98th Percentile Hourly Mean Concentration (ouE/m3)		Receptor Sensitivity	Impact Descriptor
R1	Dwelling to the S	0.47	2021	High	Negligible
R2	Dwelling to the S	0.10	2023	High	Negligible
R3	Dwelling to the S	0.05	2021	High	Negligible
R4	Dwelling to the SE	0.30	2022	High	Negligible
R5	Dwelling to the SE	0.33	2022	High	Negligible
R6	Dwelling to the SE	0.96	2022	High	Negligible
R7	Dwelling to the SE	0.92	2022	High	Negligible
R8	Dwelling to the SE	0.86	2021	High	Negligible
R9	Dwelling to the E	0.49	2021	High	Negligible
R10	Dwelling to the E	0.41	2019	High	Negligible
R11	Dwelling to the NE	0.59	2023	High	Negligible
R12	Dwelling to the NE	0.55	2019	High	Negligible
R13	Dwelling to the NE	0.24	2020	High	Negligible
R14	Dwelling to the NE	0.22	2020	High	Negligible
R15	Dwelling to the NE	0.24	2020	High	Negligible
R16	Dwelling to the NE	0.23	2023	High	Negligible
R17	Dwelling to the NE	0.25	2023	High	Negligible
R18	Dwelling to the NE	0.23	2023	High	Negligible
R19	Dwelling to the NE	0.21	2020	High	Negligible
R20	Dwelling to the NE	0.19	2023	High	Negligible
R21	Dwelling to the NE	0.26	2023	High	Negligible
R22	Dwelling to the NE	0.32	2020	High	Negligible
R23	Dwelling to the NE	0.33	2020	High	Negligible
R24	Dwelling to the NE	0.28	2023	High	Negligible
R25	Dwelling to the N	1.60	2021	High	Slight

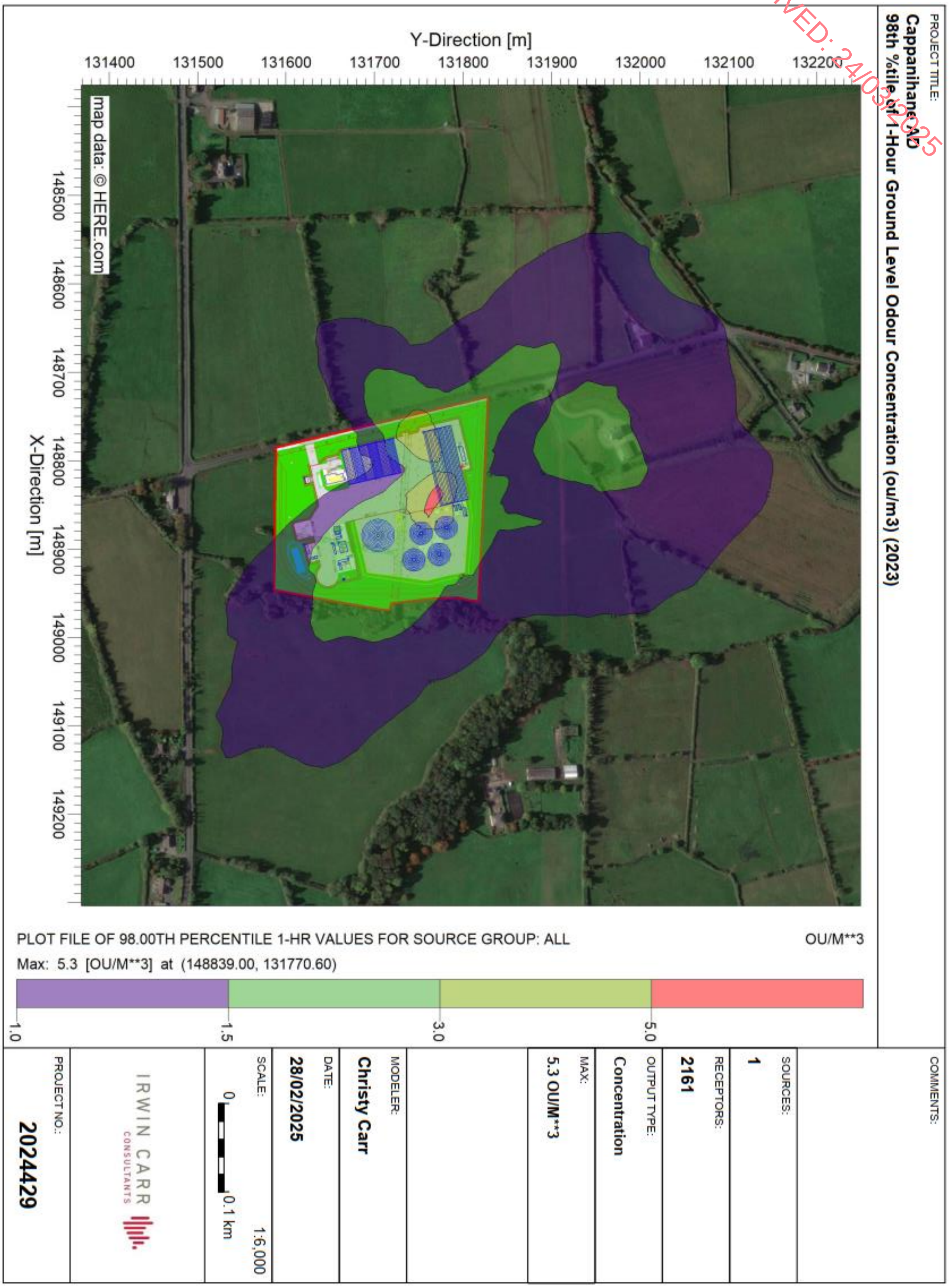
Receptor ID		Maximum Annual 98th Percentile Hourly Mean Concentration (ouE/m3)		Receptor Sensitivity	Impact Descriptor
R26	Dwelling to the N	1.29	2022	High	Negligible
R27	Dwelling to the N	0.91	2021	High	Negligible
R28	Dwelling to the N	0.79	2019	High	Negligible
R29	Dwelling to the N	0.57	2020	High	Negligible
R30	Dwelling to the N	0.55	2021	High	Negligible
R31	Dwelling to the N	0.49	2021	High	Negligible
R32	Dwelling to the N	0.47	2021	High	Negligible
R33	Dwelling to the N	0.44	2021	High	Negligible
R34	Dwelling to the N	0.46	2020	High	Negligible
R35	Dwelling to the N	0.41	2021	High	Negligible
R36	Dwelling to the NW	0.35	2023	High	Negligible
R37	Dwelling to the NW	0.36	2021	High	Negligible
R38	Dwelling to the NW	0.36	2022	High	Negligible
R39	Dwelling to the NW	0.49	2021	High	Negligible
R40	Dwelling to the NW	0.53	2021	High	Negligible
R41	Dwelling to the NW	0.52	2019	High	Negligible
R42	Dwelling to the NW	0.50	2019	High	Negligible
R43	Dwelling to the NW	0.55	2019	High	Negligible
R44	Dwelling to the NW	0.25	2021	High	Negligible
R45	Dwelling to the NW	0.20	2021	High	Negligible
R46	Dwelling to the W	0.42	2022	High	Negligible
R47	Dwelling to the W	0.25	2022	High	Negligible
R48	Dwelling to the W	0.14	2023	High	Negligible
R49	Dwelling to the SW	0.04	2023	High	Negligible
R50	Dwelling to the SW	0.03	2023	High	Negligible
R51	Dwelling to the SW	0.03	2023	High	Negligible
C1	Farmyard to the SE	0.25	2023	High	Negligible
C2	Farmyard to the S	0.04	2021	High	Negligible
C3	Farmyard to the SE	0.29	2022	High	Negligible
C4	Farmyard to the NE	0.10	2023	High	Negligible
C5	Farmyard to the NE	0.26	2020	High	Negligible
C6	Farmyard to the NE	0.29	2023	High	Negligible

Receptor ID		Maximum Annual 98th Percentile Hourly Mean Concentration (ouE/m3)		Receptor Sensitivity	Impact Descriptor
C7	Farmyard to the NE	0.29	2023	High	Negligible
C8	Farmyard to the N	0.41	2020	High	Negligible
C9	Farmyard to the NW	0.31	2022	High	Negligible
C10	Farmyard to the NW	0.38	2023	High	Negligible
C11	Farmyard to the W	0.18	2021	High	Negligible
C12	Farmyard to the W	0.27	2023	High	Negligible
C13	Farmyard to the W	0.14	2022	High	Negligible

As indicated in **Table 9.21**, the significance of odour impacts has been predicted to be no worse than ‘Negligible’ at all receptors.

The AG5 guidance states that only if the impact is greater than slight, the effect is considered significant. As such, the impact at all of the receptors is considered not significant, in accordance with the stated methodology.

Figure 9.5: Modelled 98th Percentile Hourly Ground Level Mean Concentration (ou_E/m^3)


PROJECT TITLE:
98th %tile of 1-Hour Ground Level Odour Concentration (ou/m3) (2023)
Y-Direction [m]
131400 131500 131600 131700 131800 131900 132000 132100 132200
X-Direction [m]
148500 148600 148700 148800 148900 149000 149100 149200
map data: © HERE.com
PLOT FILE OF 98.00TH PERCENTILE 1-HR VALUES FOR SOURCE GROUP: ALL
OU/M**3
Max: 5.3 [OU/M**3] at (148839.00, 131770.60)
1.0 1.5 3.0 5.0
PROJECT NO.:
2024429
IRWIN CARR CONSULTANTS
SCALE:
1:6,000
0 0.1 km
DATE:
28/02/2025
MODELER:
Christy Carr
MAX:
5.3 OU/M**3
OUTPUT TYPE:
Concentration
RECEPTORS:
2161
SOURCES:
1
COMMENTS:

NO_2

For the purposes of this assessment the emissions of oxides of nitrogen have been recorded as nitrogen dioxide in the risk assessment (as nitrogen oxide converts to nitrogen dioxide over time) as follows:

- For short-term PCs and PECs, assume only 50% of emissions of oxides of nitrogen convert to nitrogen dioxide in the environment
- For long-term PCs and PECs, assume all oxides of nitrogen convert to nitrogen dioxide

NO_2 modelling was carried out for each individual year with the results at the nearest sensitive locations presented in **Table 9.22** and **9.23** below. All results are the NO_2 concentration in µg/m^3.

Table 9.22: Annual Average NO_2 concentrations at nearest residential locations

Location	2019	2020	2021	2022	2023	Average
R1	0.60	0.69	0.82	0.59	0.64	0.67
R2	0.16	0.16	0.22	0.15	0.20	0.18
R3	0.12	0.11	0.16	0.10	0.10	0.12
R4	0.50	0.47	0.60	0.49	0.42	0.50
R5	0.52	0.48	0.61	0.51	0.44	0.51
R6	1.91	1.87	2.10	1.79	1.66	1.87
R7	1.92	1.62	1.98	1.59	1.60	1.74
R8	1.69	1.41	1.73	1.37	1.41	1.52
R9	0.90	0.78	0.76	0.62	0.78	0.77
R10	0.80	0.76	0.64	0.59	0.75	0.71
R11	0.66	0.88	0.50	0.74	0.76	0.71
R12	0.61	0.81	0.44	0.68	0.69	0.65
R13	0.31	0.41	0.21	0.33	0.35	0.32
R14	0.29	0.38	0.20	0.30	0.33	0.30
R15	0.34	0.45	0.27	0.36	0.39	0.36
R16	0.34	0.45	0.30	0.37	0.39	0.37
R17	0.34	0.46	0.32	0.38	0.40	0.38
R18	0.34	0.46	0.36	0.40	0.42	0.39
R19	0.31	0.42	0.33	0.37	0.39	0.37
R20	0.26	0.37	0.27	0.31	0.33	0.31
R21	0.33	0.40	0.35	0.37	0.39	0.37
R22	0.42	0.46	0.37	0.44	0.48	0.43
R23	0.42	0.46	0.38	0.44	0.48	0.44
R24	0.39	0.43	0.34	0.42	0.45	0.41

ORS

Location	2019	2020	2021	2022	2023	Average
R25	1.27	1.23	1.41	1.34	1.40	1.33
R26	1.06	0.88	1.03	1.17	1.14	1.06
R27	0.76	0.75	0.84	0.76	0.82	0.78
R28	0.67	0.67	0.73	0.67	0.75	0.70
R29	0.57	0.64	0.62	0.58	0.63	0.61
R30	0.57	0.57	0.61	0.56	0.63	0.59
R31	0.56	0.56	0.58	0.56	0.61	0.57
R32	0.56	0.53	0.58	0.57	0.58	0.56
R33	0.54	0.52	0.56	0.55	0.57	0.55
R34	0.49	0.57	0.52	0.52	0.56	0.53
R35	0.52	0.49	0.53	0.53	0.54	0.52
R36	0.60	0.45	0.51	0.56	0.54	0.53
R37	0.69	0.53	0.59	0.66	0.61	0.62
R38	0.68	0.55	0.60	0.67	0.61	0.62
R39	0.77	0.64	0.69	0.74	0.70	0.71
R40	0.74	0.63	0.69	0.72	0.68	0.69
R41	0.73	0.60	0.68	0.70	0.67	0.68
R42	0.72	0.60	0.68	0.69	0.67	0.67
R43	0.77	0.62	0.71	0.73	0.71	0.71
R44	0.45	0.35	0.42	0.39	0.40	0.40
R45	0.39	0.30	0.35	0.32	0.33	0.34
R46	0.25	0.30	0.25	0.23	0.30	0.27
R47	0.19	0.23	0.19	0.18	0.24	0.21
R48	0.14	0.18	0.14	0.13	0.19	0.15
R49	0.09	0.15	0.14	0.17	0.13	0.14
R50	0.08	0.14	0.14	0.15	0.13	0.13
R51	0.07	0.10	0.10	0.11	0.11	0.10
C1	0.50	0.46	0.54	0.44	0.51	0.49
C2	0.09	0.09	0.13	0.09	0.09	0.10
C3	0.44	0.43	0.52	0.46	0.37	0.44
C4	0.17	0.22	0.12	0.17	0.20	0.17
C5	0.35	0.45	0.38	0.41	0.43	0.40

Location	2019	2020	2021	2022	2023	Average
C6	0.36	0.43	0.38	0.40	0.42	0.40
C7	0.40	0.43	0.35	0.43	0.45	0.41
C8	0.48	0.56	0.50	0.51	0.56	0.52
C9	0.41	0.32	0.38	0.46	0.40	0.39
C10	0.64	0.47	0.53	0.59	0.57	0.56
C11	0.38	0.29	0.34	0.30	0.30	0.32
C12	0.22	0.27	0.22	0.18	0.26	0.23
C13	0.13	0.16	0.14	0.14	0.18	0.15
Limit	**40**	**40**	**40**	**40**	**40**	**40**

Table 9.23 below details the 99.8% of Max 1-Hour NO_2 concentration at each of the sensitive receptors for the MET Data 2019 – 2023

Table 9.23: Short Term NO_2 concentrations at nearest residential locations

Location	99.8% of Max 1-Hour
R1	21.4
R2	6.5
R3	5.9
R4	8.2
R5	8.3
R6	20.8
R7	17.5
R8	15.5
R9	9.6
R10	9.5
R11	15.8
R12	14.4
R13	7.8
R14	7.6
R15	8.7
R16	8.6
R17	8.7
R18	8.6
R19	8.1

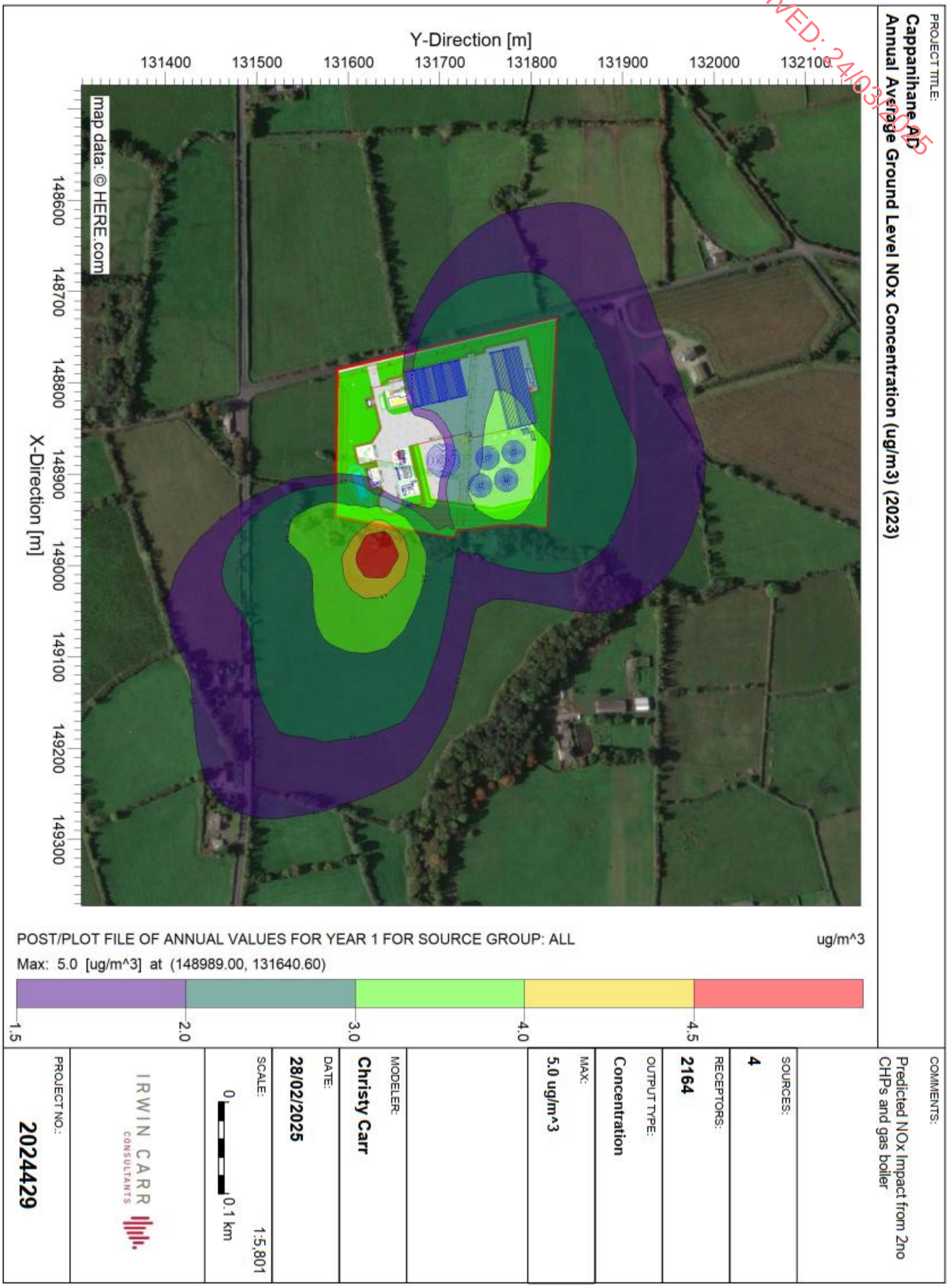
ORS

Location	99.8% of Max 1-Hour
R20	7.3
R21	7.5
R22	9.0
R23	8.7
R24	9.9
R25	18.9
R26	15.8
R27	12.2
R28	11.5
R29	10.0
R30	10.5
R31	11.4
R32	10.7
R33	10.8
R34	9.1
R35	10.4
R36	11.2
R37	14.9
R38	15.6
R39	11.8
R40	11.7
R41	11.4
R42	11.5
R43	11.8
R44	9.4
R45	8.3
R46	10.5
R47	8.6
R48	7.1
R49	6.5
R50	7.0
R51	5.4

Location	99.8% of Max 1-Hour
C1	10.5
C2	5.4
C3	8.1
C4	5.1
C5	8.5
C6	7.8
C7	9.6
C8	9.3
C9	8.4
C10	11.4
C11	8.3
C12	9.3
C13	7.2
Limit	**200**

The results above have assumed that 50% of short-term emissions of oxides of nitrogen convert to nitrogen dioxide.

Figure 9.6: Modelled Annual Average NOx Concentrations (ug/m^3)


PROJECT TITLE:
Cappanihane AD
Annual Average Ground Level NOx Concentration (ug/m3) (2023)
Y-Direction [m]
131400
131500
131600
131700
131800
131900
132000
132100
X-Direction [m]
148600
148700
148800
148900
149000
149100
149200
149300
map data: © HERE.com
POST/PLOT FILE OF ANNUAL VALUES FOR YEAR 1 FOR SOURCE GROUP: ALL
ug/m^3
Max: 5.0 [ug/m^3] at (148989.00, 131640.60)
1.5
2.0
3.0
4.0
4.5
COMMENTS:
Predicted NOx Impact from 2no CHPs and gas boiler
SOURCES:
4
RECEPTORS:
2164
OUTPUT TYPE:
Concentration
MAX:
5.0 ug/m^3
MODELER:
Christy Carr
DATE:
28/02/2025
SCALE:
1:5,801
0
0.1 km
IRWIN CARR CONSULTANTS
PROJECT NO.:
2024429

CO

CO modelling was carried out for each individual year with the results at the nearest sensitive location presented in **Table 9.24** below. All results are the CO concentration in μg/m³.

Table 9.24: Maximum Daily 8-Hour Mean CO concentration at nearest residential locations

Location	2019	2020	2021	2022	2023	Average
R1	135.4	137.3	126.1	71.4	224.6	139.0
R2	38.4	35.8	41.9	20.8	47.5	36.9
R3	26.9	27.7	26.0	22.7	24.3	25.5
R4	52.9	41.7	41.6	32.9	36.9	41.2
R5	50.3	42.3	41.1	32.2	38.9	41.0
R6	110.2	112.3	129.4	111.3	118.5	116.4
R7	105.7	90.4	91.4	94.4	101.8	96.8
R8	86.1	84.7	75.8	76.7	94.1	83.5
R9	49.7	53.7	69.9	60.2	81.9	63.1
R10	64.9	54.6	58.4	53.8	59.9	58.3
R11	75.1	66.2	63.7	62.3	76.8	68.8
R12	73.6	61.3	62.2	54.8	86.7	67.7
R13	43.1	28.4	24.5	32.4	54.1	36.5
R14	39.4	28.1	21.7	26.7	42.7	31.7
R15	35.8	48.9	37.4	29.1	45.7	39.4
R16	39.9	52.4	41.2	41.2	40.8	43.1
R17	45.6	50.3	40.5	48.2	46.4	46.2
R18	49.6	51.8	47.5	62.7	50.6	52.4
R19	46.9	47.9	46.5	59.5	46.7	49.5
R20	40.8	38.2	43.4	43.0	39.0	40.8
R21	43.2	32.0	37.3	48.7	45.0	41.2
R22	44.0	35.9	51.7	54.6	54.0	48.0
R23	45.7	29.6	52.2	54.4	46.6	45.7
R24	37.8	69.7	33.6	59.9	57.1	51.6
R25	109.5	113.9	126.4	115.5	124.1	117.9
R26	81.4	83.8	80.6	104.6	100.8	90.3
R27	52.3	65.2	74.2	62.7	54.3	61.7
R28	45.1	52.8	61.5	55.7	50.5	53.1

ORS

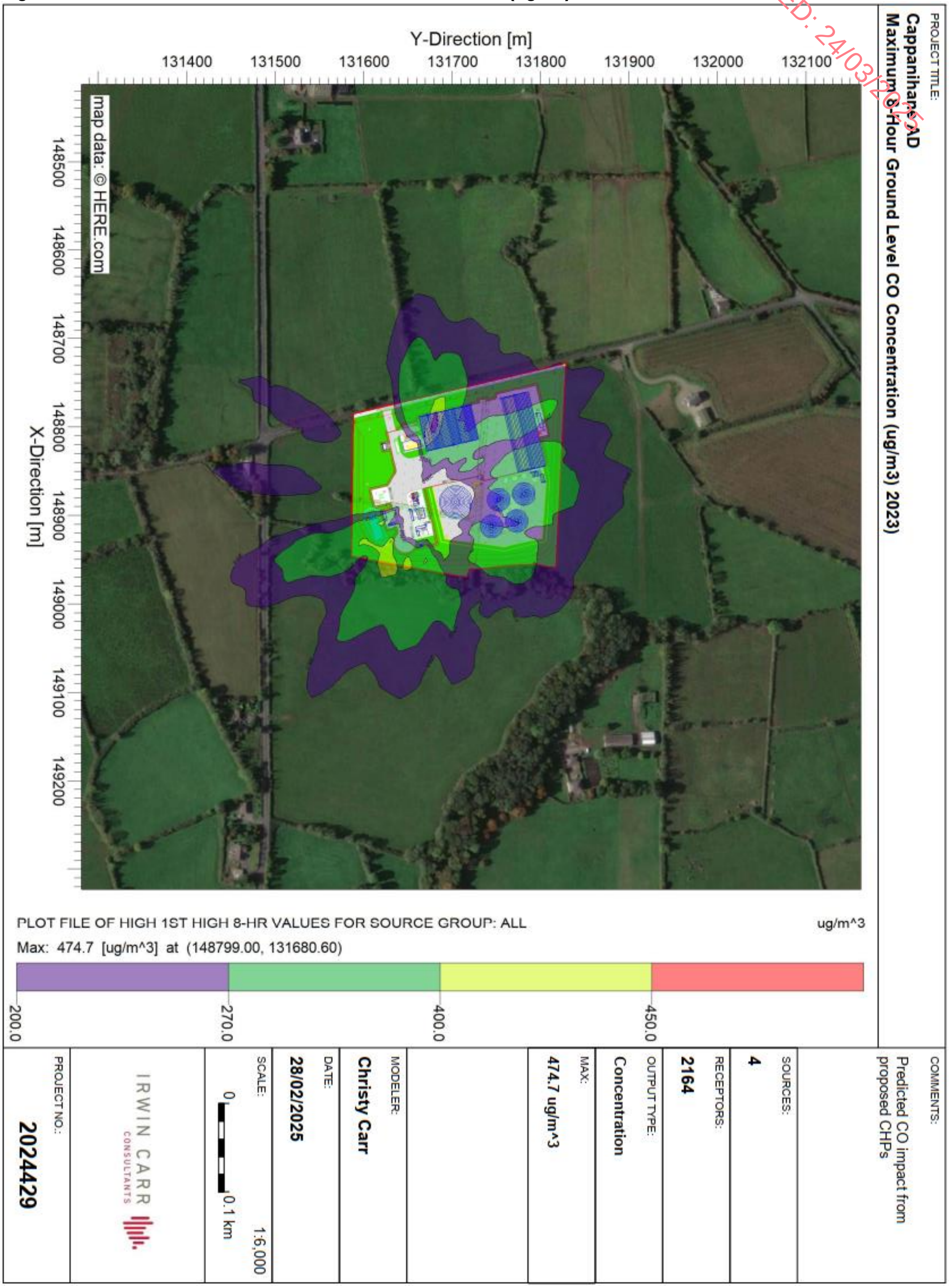
RECEIVED: 24/03/2025

Location	2019	2020	2021	2022	2023	Average
R29	44.4	49.6	49.9	40.6	52.1	47.3
R30	43.4	41.3	49.2	49.9	49.6	46.7
R31	49.5	37.6	47.0	46.1	55.4	47.1
R32	47.0	34.4	38.4	41.8	47.9	41.9
R33	49.8	33.7	40.7	37.7	55.7	43.5
R34	42.0	52.6	48.3	40.2	49.3	46.5
R35	47.1	31.0	36.4	36.7	52.2	40.7
R36	55.0	37.6	61.6	42.5	41.3	47.6
R37	75.0	54.2	70.0	56.7	56.5	62.5
R38	68.5	66.7	60.0	64.3	47.8	61.5
R39	51.2	54.7	52.1	71.9	54.4	56.9
R40	50.1	58.4	56.1	79.0	59.2	60.6
R41	51.8	57.5	54.9	77.1	60.3	60.3
R42	52.3	56.4	53.8	74.5	61.6	59.7
R43	57.1	61.1	51.2	76.1	65.4	62.2
R44	44.9	40.5	46.2	35.4	34.4	40.3
R45	42.8	34.5	39.4	37.5	31.6	37.2
R46	115.8	33.6	36.3	56.8	77.3	64.0
R47	87.6	38.5	26.1	51.1	58.4	52.3
R48	58.8	41.1	23.0	42.2	45.4	42.1
R49	42.6	40.4	39.8	27.1	39.5	37.9
R50	31.8	41.9	36.1	38.0	52.1	40.0
R51	17.4	30.4	27.2	28.9	39.3	28.6
C1	56.2	47.8	64.4	55.5	44.3	53.7
C2	18.9	22.6	23.3	20.5	18.3	20.7
C3	39.1	42.4	38.1	44.2	31.7	39.1
C4	25.4	19.8	14.1	18.1	24.5	20.4
C5	52.9	47.5	52.1	62.3	50.5	53.1
C6	50.0	31.5	39.0	49.2	49.0	43.8
C7	37.7	66.6	34.9	60.5	52.1	50.4
C8	38.7	48.8	46.3	39.1	50.6	44.7
C9	37.6	24.8	42.1	37.8	34.5	35.4

Location	2019	2020	2021	2022	2023	Average
C10	56.6	39.8	65.3	45.0	42.6	49.9
C11	38.9	38.6	33.4	45.3	32.7	37.8
C12	83.3	41.8	42.7	44.3	64.2	55.2
C13	58.7	39.0	23.5	44.1	51.2	43.3
Limit	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**

The predicted 8-hour ground level CO concentrations in each year, as well as the 5-year average are significantly below the limit values.

Figure 9.7: Modelled Maximum 8-Hour CO Concentrations (ug/m^3)



Receptor Summary

Table 5 below compares the highest annual average predicted levels at the residential receptors where:

- The Process contribution (PC)- the maximum modelled concentration of the substance due to process emissions alone
- Predicted Environmental Concentration (PEC) – that is, the maximum modelled concentration due to process emissions combined with estimated baseline concentrations.
- PC and PEC as a percentage of the objective or guideline.

In relation to the predicted short-term peak 1-hr concentrations, twice the background concentration level was added to the predicted environmental concentration (PEC) (UK Environment Agency).

Table 9.25: Air Quality Summary

Pollutant	Limit Type	Value (µg/m³)	Baseline (µg/m³)	Max Level (µg/m³)	PEC (µg/m³)	PC of limit (%)	PEC of Limit (%)
Nitrogen Dioxide (NO_2)	99.8% max 1-hr	200	14.6	22.0	36.6	**11.0**	18.3
	Annual Avg	40	7.3	2.10	9.4	**5.2**	23.5
Carbon Monoxide (CO)	8-hr mean	10,000	0.3	224.6	224.9	**2.2**	2.2
Odour	98th %tile of 1-Hour	3	0	1.60	1.60	**53.5**	53.5

**The maximum annual average levels for Nitrogen Dioxide and Carbon Monoxide are predicted when the volume flow from the proposed facility is at 75%, rather than a maximum. Full details of the assessment undertaken at 75% volume flow are included in Appendix 9.5.*

It can be seen that the worst case predicted level at any residential locations in the vicinity of the development do not exceed the limit level when considered as a PC or PEC.

It should also be noted that the PC under maximum operations does not exceed 75% of the ambient air quality standards, based on the maximum emission limits of the stacks.

9.5.5 Critical Levels and Critical Loads for Designated Ecological Sites

A review has been completed with regard to emissions from the Proposed Development on critical levels and loads for designated sites within 15km of site, shown in **Table 9.19**.

Nitrogen Conversion

The Critical Load specifies the annual nitrogen that can be deposited for a given area per year. Below this level, sensitive habitat should not be affected. The dry deposition flux (µg/m$^{2/}$s of NO_2) was calculated using AQTAG06 (Technical Guidance on Detailed Modelling Approach for an Appropriate Assessment for Emissions to Air), where the predicted ground level of NO_2 (in µg/m^3) was multiplied by the relevant deposition velocity.

The dry deposition was then multiplied by the conversion factor provided in the guidance to convert to the levels of kg.N/ha/yr. The conversion factors are provided in Table 8.1 and 8.2 of the AQTAG06 as presented in the **Table 9.26** below.

Table 9.26: Conversion Factors

Pollutant	NH_3 Deposition Velocity (m/s)	Conversion Factor
NO_2 to N	0.0015 (short vegetation)	95.9

Table 9.27 below converts the highest Process Contribution in µg/m^{-3} to kg.N/ha/yr, using the conversion factors detailed in **Table 9.26** above.

Table 9.27: Conversion of Highest NO_2 Results

Location	Pollutant	Highest PC (µg/m^{-3})*	$N0_2$ Deposition Velocity (m/s)	Conversion Factor	Highest PC (kg.N/ha/yr)
DS1	NO_2 to N	0.022	0.0015 (short vegetation)	95.9	0.0031
DS2		0.012			0.0017
DS3		0.013			0.0018

**The highest PC at all locations is predicted when the volume flow from the facility is at 100%, rather than at 75%. Full details of the assessment undertaken at 75% are included in Appendix 9.5.*

It should be noted that the worst-case results presented in the Table above take account of the additional assessment undertaken, which accounts for the facility at 75% volume flow rather than maximum capacity.

Using similar methodology to the assessment undertaken in **Section 9.5.4** above the PC and PEC can be seen in **Table 9.28** below.

Table 9.28: Nitrogen concentration at designated ecologically sensitive locations.

Location		Critical Load (kg N/ha/yr)	Background (kg N/ha/yr)	Highest PC (kg.N/ha/yr)	PEC (kg N/ha/yr)	PC/ Guideline level (%)	PEC/ Guideline level (%)
E1	Galtee Mountains SAC	10	6.83	0.0031	6.83	0.03	68
E2	Lower River Suir SAC	10	7.39	0.0017	7.39	0.02	74
E3	Ballyhoura Mountains SAC	10	6.43	0.0018	6.43	0.02	64

The PC at all locations is less than 0.3kg.N/ha/yr, and as a result would be considered negligible for the purposes of the Nitrogen assessment.

In addition, it can be seen that the maximum predicted Nitrogen deposition is significantly <1% at all of the locations assessed, and the Critical Level of Nitrogen is not exceeded at any location.

9.5.6 Human Health

Air dispersion modelling was completed to evaluate the potential effects of the planned development regarding EU ambient air quality standards which were established on the grounds of protecting human health. As shown by the models results, projected ambient concentrations including background levels fall within all National and EU ambient air quality limit values and, thus, will not cause a significant impact on human health.

Conservative and robust assumptions were made defining the input data for the air dispersion model, this methodology results in an over-estimation of actual real-world levels that are likely to be generated.

9.5.7 Impact from other Potential Emissions Points

The 1no. flare will operate infrequently therefore it is envisaged that this emission point will have an insignificant effect on local air quality beyond the site boundary. The effect to air quality and climate from the flare is classed as negligible.

The proposed pressure relief valves and digestor vents also have the potential to release emissions to the atmosphere however due to the infrequent extent of these emissions, small scale nature and mitigation features included as part of plant design these emissions are considered not significant as a source for possible impacts to local air quality and odour. A review of associated mitigation features with regard to process emissions to the atmosphere can be viewed in **Section 9.6.2**.

Another possible source of nuisance emission is fugitive odour emissions from transfer and handling of feedstock arriving to site. A review of intended abatement measures associated with this type of odour emissions can be found in **Section 9.6.2**.

9.5.8 Traffic

The volume of traffic associated with the planned development will not be significant during both operation and construction, quantitative evaluation of ambient air quality and climate impacts was not required under the criteria from the TII guidelines (2011) (see **Section 9.3.2**). During site operation the planned development will cause an extra 10 HGV/day during sites busiest periods to the neighbouring road network and is below the 200HGV level for change in traffic volumes which requires a quantitative assessment. Therefore, the influence from traffic linked to the planned development with regard to climate will be long term and not significant.

9.5.9 Climate

Producing biogas for use as a fuel source is deemed CO_2 positive and consequently does not add GHGs to the environment as long as efficient recovery and combustion for heat and/or power as it substitutes the need for fossil fuels.

The generation of *ca.* 510-580 Nm^3 of biomethane per hour which will be distributed to the gas network for use as an alternative to conventional fossil fuels. The outcome of the Proposed Development once in operation will be a slight, positive, long-term effect on climate and regional air quality. Therefore, the Proposed Development will have a slight positive impact on reducing agricultural greenhouse gas emissions in County Waterford and national greenhouse gas emissions in accordance with the Climate Action Plan (Government of Ireland, 2024).

The planned development will be self-reliant with regard to heat and power production as the CHP and biomethane boiler onsite will both run on the biomethane generated at the plant.

9.5.10 Decommissioning Phase

The decommissioning stage climate and air quality impacts will be similar to those defined for the construction stage of the planned development.

9.5.11 Risks of Accidents and Disasters

The planned development will be licenced under the Industrial Emissions (IE) Directive; therefore the site will conform with all appropriate legislation and will apply all risk reduction processes as specified within the relevant IE licence in order to avoid off-site impacts. Additionally, the Proposed Development will conform with all appropriate health and safety guidelines and legislation.

A screening evaluation for SEVESO for the planned development has shown that no further assessment is necessary (**see Section 2.3.3, Chapter 2** for further details). With regard to the construction stage of the development, the contractor will ensure that the construction area is compliant with all relevant health and safety guidelines and legislation.

9.6 Mitigation Measures and Monitoring

9.6.1 Construction Phase

The continuous management of fugitive dust will reduce significant dust emissions and mitigate once it has been created. The assigned contractor will be responsible for the control and ongoing monitoring of the dust management plan throughout the entire construction period. The aim of dust management is to safeguard against significant dust nuisance. To achieve a transparent and regulated approach, the following managed plan has been developed, this is guided by best practice from Ireland, the UK (IAQM 2024, BRE 2003, Scottish Office 1996 and UK ODPM 2002). and the USA (USEPA 1997).

Site Dust Management Plan

The aim is to provide appropriate site supervision by inhibiting dust to develop to unsuitable airborne levels at source. This is to be accomplished by appropriate site strategy and well known/established control procedures.

Throughout the construction planning stage, the location of activities and storage piles will acknowledge and recognise nearby sensitive receptors/locations and existing prevailing winds to inhibit the chance of significant dust nuisance/soiling (see **Figure 9.2** for Windrose for Fermoy Meteorological Station).

The prevailing wind is mainly westerly to south-westerly therefore construction compounds and storage piles should be located downwind of sensitive receptors/locations to decrease the likelihood for nuisance dust to affect/occur at sensitive receptors.

Suitable site supervision will involve the capacity to respond to unfavourable weather conditions by restricting construction activities on-site or by immediate effective control measures prior to the likelihood of nuisance incidences.

Throughout periods where rainfall is greater than 0.2mm/day, dust generation is generally suppressed (BRE 2003, UK ODPM 2002). The likelihood of significant dust incidences is also connected to threshold wind speeds greater than 10 m/s (19.4 knots) (at 7m above ground) to displace loose material from storage piles and other exposed materials (USEPA 1986). Due care should be practiced during site works during periods of high wind as these are times where the possibility for significant dust emissions is highest. The prevailing meteorological conditions in the site locality are favourable for dust suppression on average for the majority of an average meteorological year. However, there will be instances where due diligence will be necessary to ensure dust nuisance events are not experienced. Below details examples of the methods that shall be used during periods of unfavourable meteorological events:

- Contractors shall have good site management procedures throughout the construction works to avoid the creation of airborne dust. Contractors are obliged to guarantee that sufficient preventive measures to limit dust generation are employed through suitable method statements, accounting for the risks and mitigation measures described in the CEMP.
- Throughout working hours, dust control procedures will be assessed as appropriate, subject to the prevailing meteorological conditions.
- The name and contact details of an appropriate person to contact concerning air quality and dust issues shall be exhibited on the site boundary, this notice board should also detail head/regional office contact details.

- It is advisable that community engagement commence before works begin on site describing the nature and duration of the works to local residents and businesses.
- Where complaints are received concerning dust, records will be maintained including likely causes and suitable action taken to alleviate any issues as a result of the construction. Management of any complaints will be done in conjunction with a suitable Complaints Procedure.
- During activities which pose a high probability of dust production and/or during periods of adverse weather conditions the rate of site inspections should be increased.
- Site inspections will be completed frequently to monitor compliance with dust control strategies set out in the CEMP and the results recorded of these inspections, including nil returns.
- The dust reduction strategies should be evaluated at regular intervals during the project to preserve the effectiveness of the techniques employed and to safeguard the minimisation of dust using best practice and procedures. In the event of dust spoiling/nuisance occurring beyond the boundary of the site, site activities will be assessed, and suitable measures utilized to negate the nuisance. Outlined dust mitigation measures to be employed are described below.
- Fully enclose or cover certain operations, where possible, when there is a high possibility for dust generation.
- Prevent site runoff of water or mud.
- Keep site barriers and fencing clean using watering procedures.
- Remove materials that have the capability to produce dust from site as soon as practicable, unless being reused on site.
- Opt for mains or battery powered equipment in preference to diesel or petrol powered generators where practicable.
- Use cutting or grinding equipment fitted with suitable dust suppression techniques such as water sprays or local extraction.
- Make certain an adequate water supply is available on the site for effective dust/particulate matter suppression/mitigation.
- Use enclosed chutes and conveyors and covered skips.
- Reduce drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever possible.
- Make certain 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.
- Strictly no bonfires or burning of waste materials on site.

<u>Site Roads / Haulage Route</u>

Construction HGV/truck activities on site roads (especially unpaved roads) can be a substantial source of fugitive dust if suitable control measures have not been applied. The use of speed restrictions is commonly the most effective way of suppressing dust on unpaved haul roads. Various studies have proven that this method can have an effectiveness varying from 25 to 80% (UK ODPM 2002):

- A speed limit of 15km/hr will be applied as an effective control measure for dust for on-site vehicles utilising unpaved road surfaces.
- Entrance gates should be located at a minimum 10m from local sensitive receptors as much as is reasonably practical/possible.
- Watering of the site will be utilised during periods of prolonged dry weather to ensure unpaved or areas associated with problematic dust are kept moist. Frequency of

watering will be dependent on weather conditions, vehicle activity and soil type, dust suppression such as sprinklers, bowsers etc. should be available during the construction phase.

- A road sweeper will be applied as required to control mud and dust on the site access roads.
- All vehicles must switch off engines once stationery i.e. no idling vehicles on site.
- Vehicles entering and leaving sites must be covered to prevent dusty emissions from materials during transport.
- Document all inspections of haul roads and any follow-up action in a site logbook.
- Employ a wheel washing system with rumble grids to remove collected dust and mud prior to leaving the site where reasonable.
- Sand and other aggregates must be stored in bunded areas and are not allowed to dry out and become airborne, unless this is required, in which case ensure that appropriate additional control measures are in place.
- Bulk cement and other fine powder materials must be delivered in covered tankers and stored in silos with suitable control systems to negate escape from material and overfilling during delivery.

Land Stripping / Earth Moving

Land stripping / earth-moving works throughout periods of high winds and dry weather conditions can be a significant cause of dust.

- Throughout dry and windy periods, and when there is a possibility of dust nuisance, watering shall be performed to ensure moisture content of materials being relocated is high enough to increase the stability of the soil and thus suppress dust.
- During times of very high winds (gales), actions likely to generate significant dust emissions should be rescheduled until the gale has receded.
- Revegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable
- Use hessian mulches where it is not possible to revegetate or cover with topsoil, as soon as is practicable
- Only remove covers in small areas during work and not all at once.

Storage Piles

The position and moisture content of storage piles are key factors which determine their capacity for dust emissions. The below measures shall be utilised to minimise fugitive dust formation from storage piles:

- Overburden material shall be shielded from exposure to wind by storing the material in sheltered regions of the site. Where possible storage piles should be positioned downwind of sensitive receptors.
- Adequate watering will take place to ensure the moisture content is high enough to suppress dust. The watering of stockpiles has been found to have an 80% control efficiency (UK ODPM 2002).
- Plan site layout so that machinery and dust causing activities including stockpiling are located away from receptors, as far as is possible.
- Erect solid screens or barriers around dusty activities or the site boundary which are at least as high as any stockpiles on site.

Site Traffic on Public Roads

Escape of debris, aggregates and fine material onto public roads should be decreased to a minimum by utilising the following measures:

- Vehicles delivering or collecting material with capacity for dust emissions shall be covered with tarp, to limit the blow-off of dust.
- A wheel wash facility should be installed near the entrance of the construction site, where feasible. All trucks leaving the site must pass through the wheel wash. In addition, public roads outside the site shall be regularly inspected for cleanliness, as a minimum daily, and cleaned as necessary.

Summary of Dust Mitigation Measures

The constant control of fugitive dust will maintain the prevention of significant emissions, instead of an inefficient attempt to manage them once they have been released. The main elements with respect to control of dust will be:

- The design of a site policy on dust and the allocation of the site management responsibilities for dust management.
- The creation of a documented system for managing site practices regarding dust control.
- The development of a method by which the functionality of the dust control plan can be consistently monitored and assessed; and
- The requirement of effective procedures to handle any complaints.

These procedures will be strictly monitored and assessed continuously throughout the construction stage. In the occurrence of dust nuisance outside the site boundary, activities likely to cause dust would be restricted and adequate procedures applied to resolve the problem before the recommencement of construction operations.

Climate and Regional Air Quality

Various site-specific mitigation methods can be applied throughout the construction stage of the Proposed Development to support emissions reduction - such as the restriction of on-site or delivery vehicles from leaving engines idling, even over brief periods. Reducing waste of materials due to inadequate timing or over stocking of materials on site will assist to minimise the carbon footprint of the site.

Traffic

Traffic emissions associated with site have been projected as not significant therefore no detailed mitigation/remediation related to air and climate emissions from traffic have been described.

9.6.2 Operational Phase

Odour Emissions

The stack height of the proposed odour abatement system has been designed in an iterative fashion to ensure that an adequate height was selected to aid dispersion of the emissions and achieve compliance with indicative odour standards at all off-site locations. It has been determined that a minimum stack height of 11.0m would provide adequate dispersion to achieve compliance with the odour guideline value at all locations at or beyond the site boundary.

A variety of mitigation technologies has been integrated within the Proposed Development so as to reduce and minimise possible emission odour. Further detail of the variety and scale of proposed technologies can be found in **Chapter 2: Project Description**.

Process management and supervision are key when limiting generation of odour at a source. Emissions to the atmosphere are controlled and managed by end of process mitigation equipment and a stack height that is suitable to disperse the exhausted plume accordingly.

The odour treatment proposed for the plant will consist of an odour abatement system and carbon filters with a high range of efficiency to remove compounds such as hydrogen sulphide, ammonia and siloxanes in the exhaust gas so as to avert odour impacts of significance beyond the site boundary.

The planned biogas upgrading plant will include active sensors for CH_4, CO_2, H_2S and the gas will be recirculated back through the scrubbing process in the event that it does not meet the required levels. H_2S will be trapped on activated carbon, water vapour will be emitted to the atmosphere. All CO_2 will be captured and liquified. There will be no CH_4 emissions from the proposed biogas upgrading plant.

The following odour abatement measures have been integrated into the design of the plant:

- The reception hall has been constructed to accommodate multiple trucks to unload at any one time. This will significantly reduce the number of trucks waiting outside of the building and therefore minimising fugitive odour emissions on-site.
- The proposed Reception Hall will be designed and constructed to be maintained under negative air pressure.
- All feedstock handling activities at the facility will be carried out within a ventilated building which will be extracted to an odour abatement system using ammonia scrubbing, UV treatment and active carbon filtration to remove odorous compounds. The building will operate under negative pressure with a minimum of 2 air changes per hour. Ventilation pipe work installed in the headspace of the building will be connected to a high-volume medium-pressure fan that will draw off the warm, buoyant building air that will be generated by a combination of emissions from the feedstock materials in the intake area and from fugitive emissions from the movement of the material to the pre-treatment and digesters.
- The main entrances to the reception building will be fitted with rapid response roller shutter doors. A closed-door management strategy will be enforced.
- Treated emissions from the odour control plant in the reception building will be discharged via a 11.0m stack to enhance dispersion. The proposed location of the odour abatement system emission point within the site footprint was also designed to ensure that the distance between the emission point and the nearest sensitive receptors was maximised, thereby aiding dispersion.

The following additional mitigation measures will be adopted for the management of the Proposed Development:

- Vehicles exiting the reception building will be subjected to cleaning procedures in accordance with the DAFM Conditions Document in a designated cleaning area located outside of this door.

- Where there is a potential for odours from deliveries of feedstock, these will be delivered in covered or sealed containers.
- Feedstock delivery times will be controlled in order to minimise truck weighting times outside of the reception building and therefore minimising fugitive odour emissions on-site.
- Biobased fertiliser will be stabilised and pasteurised before storage and 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.

As described previously, the Proposed Development will be licenced by the EPA under the Industrial Emissions Directive and will therefore need to comply to all associated processes and conditions as directed by the IE licence to avoid significant impacts to local odour, climate and air quality.

Process Emissions

The proposed stack height for the CHP has been designed in an adaptive manner to guarantee that an acceptable height has been incorporated into site layout to support effective dispersion of emissions and comply with applicable EU ambient air quality standards at all offsite locations.

As a result of the air dispersion modelling evaluation, mitigation measures designed into site and planned supervision of the proposed AD facility (as described within this chapter and in Chapter 2), no supplementary abatement measures are planned for the CHP, flare and biomethane boiler stack during the operational stage of the development.

Fugitive Methane Losses

The applicant is committed to minimising methane emissions from the biomethane facility and associated operations by implementing the following mitigation measures during operation:

- **Best Available Techniques (BAT)**: The facility will adhere to BAT principles in both its design and operational phases to enhance environmental performance.
- **Gas-Tight Digestion Tanks**: All anaerobic digestion (AD) tanks will be sealed, fitted with covers, and connected to an integrated biogas collection system to prevent methane escape.
- **Controlled Feedstock Management**: All feedstocks will be managed within a dedicated Feedstock Reception Building, equipped with air handling and odour treatment systems, minimising potential emissions.
- **Biogas Storage Management**: Biogas storage membranes will typically be maintained at 50% capacity to provide a storage buffer under standard operating conditions.
- **Automated Monitoring and Control**: The facility will operate under a SCADA system, ensuring continuous 24/7 monitoring and control of all critical processes.
- **Optimised Hydraulic Retention Time (HRT)**: To reduce residual biomethane content in digestate, the AD system will maximise hydraulic retention time, maintaining a standard HRT of 60 days.
- **Digestate Pasteurisation**: All digestate will undergo pasteurisation prior to dispatch, effectively neutralising anaerobic bacteria. This treatment ensures any subsequent

breakdown of organic material is aerobic, producing CO_2 rather than methane.

- **Methane Detection Surveys**:
    - **Commissioning Surveys**: A comprehensive methane detection survey will be conducted during commissioning to identify and address any potential leaks before full operations commence.
    - **Annual Surveys**: Methane detection surveys will be performed annually to locate any emissions. Any identified leaks will be prioritised for immediate repair.
- **Lifecycle Maintenance for Gas Domes**: The applicant's lifecycle maintenance budget will include provisions for the replacement of gas domes on a 7-10 year cycle to maintain integrity.
- **Maintenance of Emergency Flares and Pressure Relief Valves (PRVs)**: Emergency flare and PRVs will be included in the facility's routine Planned Preventative Maintenance (PPM) plan to ensure reliable and efficient operation.
- **Best Practices for Fertiliser Application**: Biobased fertiliser applications will follow best practices to minimise atmospheric nitrogen emissions, contributing to environmental protection.
- **Biogenic CO_2 Capture**: When market conditions allow, the applicant will begin capturing and marketing biogenic CO_2 emissions, enhancing the facility's carbon management strategy.

9.7 Cumulative Effects

9.7.1 Construction Phase

There is potential for cumulative dust effects at adjacent site receptors should the construction stage of the planned development overlap with the construction of any other authorised development within 250m of the site. Dust alleviation measures described in **Section 9.6.1** shall be employed during the construction stage of the planned development preventing significant cumulative effects on air quality. Due to suitable mitigation measures in position, any cumulative impacts on air quality and climate linked with the construction stage of the planned development are considered short-term and not significant.

9.7.2 Operational Phase

There is a no large scale sites nearby that would add to the effects of the proposed development. Any existing sources of emissions to air have been included by way of background air quality data during the air dispersion modelling phase.

9.7.3 Indirect Impacts

Ammonia emissions to air occurs from slurry and chicken manure spreading with the use of nitrogen fertilisers. Ammonia can create particulate matter in the atmosphere which can have adverse effects on human health.

Ammonia is one of the key air pollutants monitored and reported under National Emissions Ceiling Directive (2016/2284/EU) which was ratified to give effect to the landmark UNECE Gothenburg Protocol under the Convention on Long Range Transboundary Air Pollution in 1999. Under this directive Ireland's ceiling for ammonia is 116 Kt per annum, with an obligation to decrease ammonia emissions to 107.5 Kt by 2030 or by *ca.* 10%. In 2017 Ireland infringed its ammonia ceiling emitting 11 8.4 KT of ammonia.

Using slurry/chicken manure as a feedstock for the AD process instead of land spreading will reduce ammonia emissions to air. Also, the use of digestate as a biobased fertiliser instead of inorganic nitrogen fertilizer will further reduce ammonia emissions.

The digestate produced will meet prescribed standards for digestive quality respiration activity, metals, pathogenic organisms, impurities, organic matter and maturity. The Digestate storage tank will be covered to prevent rainwater ingress and as they will contain spent digestate there will be a lower odour potential from the digested storage tank. The digestate will be spent by the time it is sent to the digestate storage tank because of the digestion process; by which time all biomethane will have been extracted. The digestate will also have undergone pasteurisation during the process. Therefore, the potential for odour will have reduced at this stage.

Therefore, the Proposed Development will have a long-term slight positive indirect effect on air quality.

9.8 Residual Impacts

According to Environmental Protection Agency guidelines, Residual Impact is described as 'the degree of environmental change that will occur after the proposed mitigation measures have taken place.' The mitigation strategy above recommends actions which can be taken to reduce or offset the scale, significance and duration of the impacts on the surrounding odour, air quality or climate.

The purpose of this assessment is to specify mitigation measures where appropriate to minimise the 'risk factor' to all aspects of air quality such as to minimize the potential for odours to be generated, air quality limits to be exceeded etc. This 'risk factor' is reduced or offset by recommending the implementation of a mitigation strategy in each area of the study. On the implementation of this mitigation strategy, the potential for impact will be lessened.

A site-specific Construction Environmental Management Plan (CEMP) will be devised and implemented throughout the duration of the construction phase. This document will contain all the necessary procedures required to prevent and minimise any environmental risks posed by the project on the surrounding environment.

9.8.1 Construction Phase

A summary of the predicted impacts associated with the construction phase in terms of quality, significance, and duration, along with the proposed mitigation measures and resulting residual impacts are summarised in **Table 9.29**.

The overall impact anticipated by the construction phase of the project following the implementation of suitable mitigation measures is considered to be negative, imperceptible to moderate, and temporary.

9.8.2 Operational Phase

A summary of the predicted impacts associated with the operational phase in terms of quality, significance, and duration, along with the proposed mitigation measures and resulting residual impacts are summarised in **Table 9.30**.

There is a slight positive long term impact at national scale in terms of climate due to the development being self-reliant and giving the grid an alternative to conventional fossil fuels. The overall impact anticipated by the operational phase of the project following the implementation of suitable mitigation measures is considered to be neutral to negative, imperceptible to slight, and temporary to long term.

Table 9.29: Summary of predicted construction phase impacts, mitigation measures and residual impact

Potential Source	Environmental Receptor	Effect Description	Quality	Significance	Duration	Mitigation	Residual Effect
Fuel Storage	Site personnel/local environment/ local receptors	Fumes released to the environment	Negative	Slight	Temporary	• Temporary Fuels used during construction will be stored in sealed containers.	Negative, Imperceptible, Temporary
Stockpiling	Site personnel/local environment/ local receptors	Dust from stockpile leaving site boundary into nearby properties/amenities or local roads	Negative	Significant	Temporary	• At the construction planning stage, the siting of activities and storage piles will take note of the location of sensitive receptors and prevailing wind directions in order to minimise the potential for significant dust nuisance. • During dry and windy periods, and when there is a likelihood of dust nuisance, watering shall be conducted to ensure moisture content of materials being moved is high enough to increase the stability of the soil and thus suppress dust	Negative Slight, Temporary
Use of heavy plant / multiple plant use	Site personnel, air pollution, local receptors	Air emissions	Negative	Slight	Temporary	• The Contractor must monitor performance of plant and machinery to ensure that the proposed mitigation measures are implemented, and that dust effects and nuisance are minimised. • The prevention of on-site or delivery vehicles from leaving engines idling, even over short periods.	Neutral, Not significant Temporary
Topsoil stripping	Site personnel/local environment/ local receptors	Dust leaving site boundary into nearby local receptors/amenities	Negative	Significant	Temporary	• During working hours, dust control methods will be monitored as appropriate, depending on the • prevailing meteorological conditions. During periods of very high winds (gales), activities likely to generate significant dust emissions should be postponed until the gale has subsided. • Overburden material shall be protected from exposure to wind by storing the material in sheltered regions of the site.	Negative, Moderate, Temporary

Potential Source	Environmental Receptor	Effect Description	Quality	Significance	Duration	Mitigation	Residual Effect
						Where possible storage piles should be located downwind of sensitive receptors. • Sufficient watering will take place to ensure the moisture content is high enough to suppress dust.	
Construction and operation of compound buildings and amenities	Site personnel/local environment/ local receptors	Dust leaving site boundary into nearby local receptors/amenities	Negative	Slight	Temporary	• Implementation of Construction Environmental Management Plan. • The specification of a site policy on dust and the identification of the site management responsibilities for dust issues. • The development of a documented system for managing site practices with regard to dust control. • The development of a means by which the performance of the dust minimisation plan can be regularly monitored and assessed. • The specification of effective measures to deal with any complaints received. • The name and contact details of a person to contact regarding environmental issues shall be displayed on the site boundary, this notice board should also include head/regional office contact details site. • 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. • At all times, the procedures put in place will be strictly monitored and assessed. • The dust minimisation measures shall be reviewed at regular intervals during the works to ensure the effectiveness of the procedures in place and to maintain the goal of minimisation of dust through the use of best practice and procedures.	Negative, Not significant Temporary

Potential Source	Environmental Receptor	Effect Description	Quality	Significance	Duration	Mitigation	Residual Effect
						• Record any exceptional incidents that cause dust and/or air emissions, either on or off site and the action taken to resolve the situation in a dedicated logbook.	

Potential Source	Environmental Receptor	Effect Description	Quality	Significance	Duration	Mitigation	Residual Effect
Constructing and operating site access roads	Local receptors, roads and environment	Site and delivery vehicles travelling on unsealed roads	Negative	Moderate	Temporary	• A speed restriction of 15 km/hr will be applied as an effective control measure for dust for onsite vehicles using unpaved site roads. • Access gates to the site shall be located at least 10m from sensitive receptors, where possible • Watering shall be conducted during sustained dry periods to ensure that unpaved areas are kept moist. • Any hard surface roads will be swept to remove mud and aggregate materials from their surface while any unsurfaced roads shall be restricted to essential site traffic only. • Vehicles delivering or collecting material with potential for dust emissions shall be enclosed or covered with tarpaulin at all times to restrict the escape of dust. • A wheel wash facility shall be installed if feasible. All trucks leaving the site must pass through the wheel wash. • Public roads outside the site shall be regularly inspected for cleanliness, as a minimum on a daily basis, and cleaned as necessary.	Negative, Slight Temporary

Table 9.30: Summary of predicted Operational phase impacts, mitigation measures and residual impact

Potential Source	Environmental Receptor	Effect Description	Quality	Significance	Duration	Mitigation	Residual Effect
Biogas Release	Local receptors, Environment	Air Emissions	Negative	Moderate	Temporary	•	Neutral, Imperceptible, Long-term
Odour Release (Various)	Local receptors, Environment	Odour Emissions	Negative	Moderate	Long-term	• The odour abatement proposed for the facility will consist of odour treatment system and carbon filters with a high level of efficiency to remove impurities such as hydrogen sulphide, ammonia, bioaerosols, siloxanes etc. in the exhaust gas to prevent odour impacts of significance beyond the site boundary. • H2S will be trapped on activated carbon; CO2 and water vapour will be emitted to the atmosphere. • The reception hall has been designed to allow for multiple trucks to unload at any one time. This will significantly reduce the number of trucks waiting outside of the building and therefore minimising fugitive odour emissions on-site. • The proposed reception building will be sealed to prevent fugitive emissions from this building • All waste activities at the facility will be carried out within a ventilated building which will be extracted to an odour abatement system using carbon filtration and / or UV methodologies to remove odorous compounds. • The building will operate under negative pressure with up to 2 air changes per hour. Ventilation pipe work installed in the headspace of the building will be connected to an industrial centrifugal fan	Neutral, Imperceptible, Long-term

Potential Source	Environmental Receptor	Effect Description	Quality	Significance	Duration	Mitigation	Residual Effect
						that will draw off the warm, buoyant building air that will be generated by a combination of emissions from the feedstock materials in the intake area and from fugitive emissions from the movement of the material to the pre-treatment and digesters. • The main entrances to the reception building will be fitted with rapid response roller shutter doors. A closed-door management strategy will be enforced. • Treated emissions from the odour control plant in the reception building will be discharged via a 11.0m stack to enhance dispersion. The proposed location of the odour abatement system emission point within the site footprint was also designed to ensure that the distance between the emission point and the nearest sensitive receptors was maximised, thereby aiding dispersion. • All feedstocks will be delivered in covered or sealed containers. • Feedstock delivery times will be controlled in order to minimise truck waiting times outside of the reception building and therefore minimising fugitive odour emissions on-site. • Digestate will be stabilised before storage and removal from the site to minimise odour generation. • As part of the company ISO14001 standard EMS, 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.	

Potential Source	Environmental Receptor	Effect Description	Quality	Significance	Duration	Mitigation	Residual Effect
Combustion Process (Various)	Local receptors, Environment	Air quality	Negative	Moderate	Long-term	• The proposed biogas upgrading plant will include in line sensors for CH4, CO2, H_2S and the gas will be recirculated back through the scrubbing process if it does not meet the required levels. • The stack height proposed for the CHP emission points have been designed in an iterative fashion to ensure that an adequate height was selected to aid dispersion of the emissions and achieve compliance with the EU ambient air quality standards at all off-site locations (including background concentrations for air pollutants).	Negative, Imperceptible, Long-Term
Dust Nuisance	Local receptors, Environment	Air quality/dust nuisance	Negative	Moderate	Long-Term	• Vehicles exiting the reception hall will be subjected to cleaning procedures in accordance with the DAFM Conditions Document in a designated cleaning area.	Negative, Imperceptible, Long-Term
Fugitive Methane Emissions	Local receptors, Environment	Air Emissions	Negative	Moderate	Long-Term	• The facility will adhere to BAT principles in both its design and operational phases to enhance environmental performance. • All anaerobic digestion (AD) tanks will be sealed, fitted with covers, and connected to an integrated biogas collection system to prevent methane escape. • All feedstocks will be managed within a dedicated Feedstock Reception Building equipped with air handling and odour treatment systems, minimising potential emissions. • Biogas storage membranes will typically be maintained at 50% capacity to provide a storage buffer under standard operating conditions. • The facility will operate under a SCADA system, ensuring continuous 24/7 monitoring and control of all critical processes.	

Potential Source	Environmental Receptor	Effect Description	Quality	Significance	Duration	Mitigation	Residual Effect
						• To reduce residual biomethane content in digestate, the AD system will maximise hydraulic retention time, maintaining a standard HRT of 60 days. • All digestate will undergo pasteurisation prior to dispatch, effectively neutralising anaerobic bacteria. This treatment ensures any subsequent breakdown of organic material is aerobic, producing CO_2 rather than methane. • Methane Detection Survey: Commissioning Survey: A comprehensive methane detection survey will be conducted during commissioning to identify and address any potential leaks before full operations commence. Annual Surveys: Methane detection surveys will be performed annually to locate any emissions. Any identified leaks will be prioritised for immediate repair. • The applicant's lifecycle maintenance budget will include provisions for the replacement of gas domes on a 7-10 year cycle to maintain integrity. • Emergency flare and PRV's will be included in the facility's routine Planned Preventative Maintenance (PPM) Plan to ensure reliable and efficient operation. • Biobased fertiliser applications will follow best practices to minimise atmospheric nitrogen emissions, contributing to environmental protection. • When market conditions allow, the applicant will begin capturing and marketing biogenic CO_2 emissions, enhancing the facility's carbon management strategy.	

Potential Source	Environmental Receptor	Effect Description	Quality	Significance	Duration	Mitigation	Residual Effect

9.9 Monitoring

Construction Phase

Dust deposition monitoring will be carried out at selected areas along the extent of the site boundary during the construction stage of the Proposed Development. As much as reasonably practical/possible monitoring should begin a minimum of 1 month prior to any site work beginning to capture baseline dust levels. The siting of dust monitoring locations will be considered based on representative monitoring with respect to sensitive receptors and prevailing wind direction. The German Standard VDI 2119 (Bergerhoff Method) will be employed where dust gauges consisting of a collection vessel and dust stand will be positioned at representatively important dust locations.

The collection vessel is fixed to the stand with the opening of the collection vessel located approximately 2m above ground level. The applicable limit value is the TA Luft limit value of 350 mg/m^2/day for a monitoring period of between 28 - 32 days.

Operational Phase

The Proposed Development will be a licenced facility under the Industrial Emissions Directive and will therefore be required to conduct “sniff surveys” in accordance with AG5 at regular intervals to demonstrate that mitigation measures are sufficient to prevent odour nuisance at sensitive off-site locations. Stack monitoring of the odour abatement system exhaust may also be required at regular intervals under the conditions of the IE Licence.

Emissions monitoring of selected point sources will also be carried out in accordance with conditions of the future IE license. Typically, this monitoring would be carried out for the CHP and odour abatement stack due to their continuous nature and being the primary point sources onsite.

9.10 Summary of Significant Impacts

The receptors for this assessment are considered to be local residences, amenities and designated sites. Whilst the development proposals have the potential to cause effects to the sensitive receptors identified, the recommended mitigation measures will ensure that the risk of potential impacts are reduced to negligible.

9.11 Statement of Significance

A worst-case assessment was utilised throughout the air quality impact study in order to assess any risk associated with the proposed operation of the plant. The scheduled emission points for the proposed anaerobic digester plant will be controlled through the EPA licensing process. The air quality impact assessment has demonstrated that the emissions will result in an acceptable air quality impact in accordance with the air quality standard regulations 2011 (S.I. No. 180 of 2011).

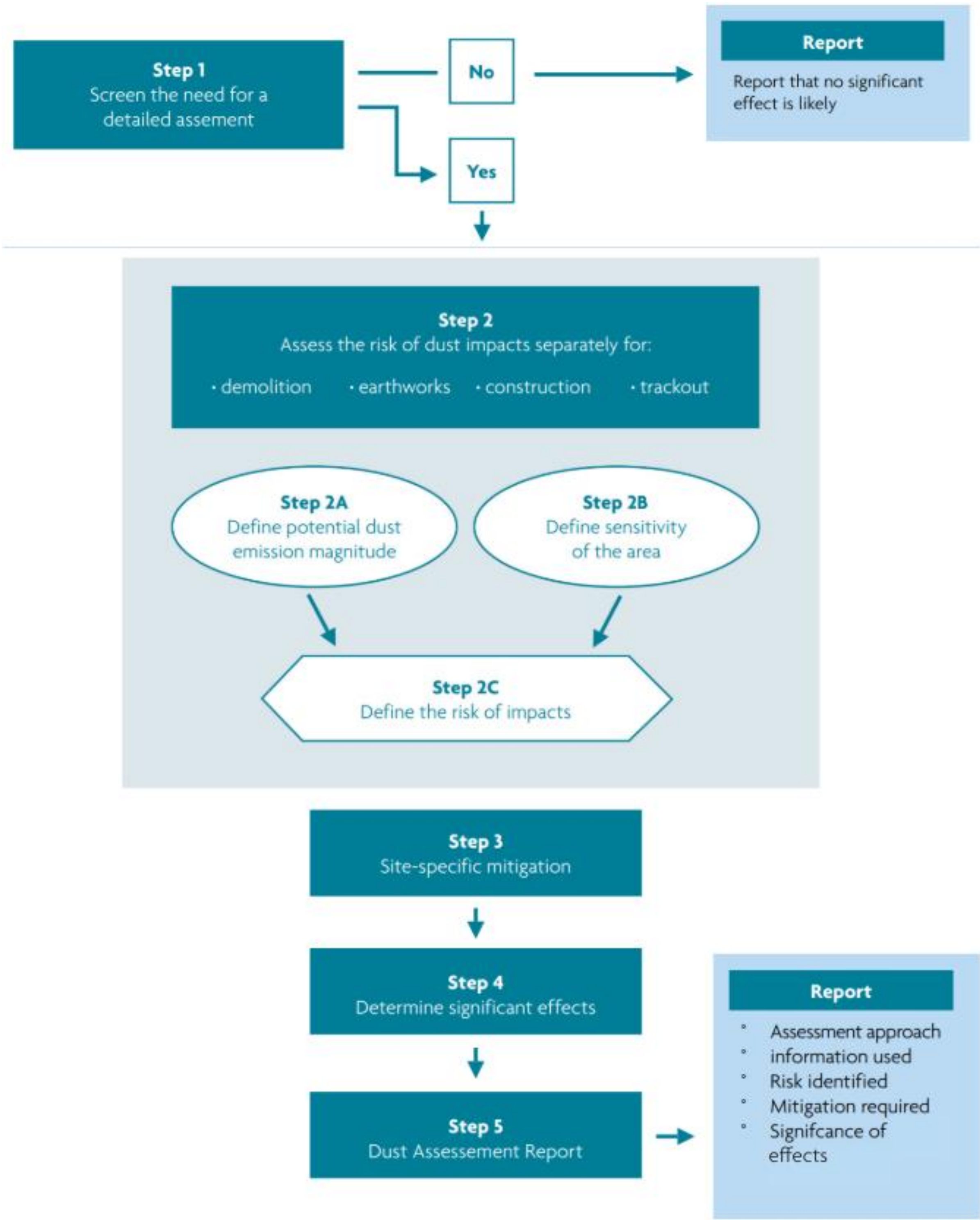
Typical ambient air emission targets, based on EPA Environment Agency criteria relevant to negating potentially high offensive odours and nuisance pollutants will be achieved at the surrounding sensitive receptors. The dispersion modelling indicates that, based on worst case emission concentrations the existing dispersion experienced in the vicinity of the site allows for the sites emissions to fall within the stringent ambient air target values.

Where a potential impact has been identified, mitigation measures have been provided which when implemented reduces the impact of significance to ***' negligible'.*** The mitigation steps are presented in Section 9.7.

APPENDIX 9.1

Methodology for construction dust assessment to evaluate the potential impacts, construction activities are divided into demolition, earthworks, construction and track out. The factors are based upon the IAQM construction dust guidance. The assessment follows the steps proposed in the guidance as per **Appendix Figure 9.1.1** below.

Appendix Figure 9.1.1: Steps to Perform a Dust Assessment (IAQM, 2024)



Step 1 and Step 2 methods from the IAQM construction dust guidance are defined below to assign dust risk categories for each of the different construction actions.

Step 1: Screen the requirement for assessment

Step 1 is to screen out the necessity for construction dust assessment at all, this is usually a somewhat conservative level of screening. An assessment is usually necessary where there is;

A human receptor within;

- 250 m of the boundary of the site or
- 50m of the route used by construction vehicles on the public highway, up to 250 m from the site entrances.

An ecological receptor;

- 50m off the site boundary
- 50m of the roots used by construction vehicles on the public highway, up to 250 m from the site entrances.

Step 2A: Defining the potential dust emission magnitude

Demolition

The dust emission magnitude classification for demolition is different for each site in terms of timing, building type, time period and size. Examples of the potential dust emission classes are provided in the guidance are as follows;

Large: total building volume > 75,000 m^3, potentially dusty construction material, on-site crushing and screening, demolition activities > 12m above ground level;.

Medium: total building volume 12,000 m^3 to 75,000 m^3, potentially dust creating construction material, demolition activities 6m to 12m above ground level

Small: total building volume < 12,000 m^3, construction material with low potential for dust release, demolition activities less than 6 meters above ground, demolition during wetter months.

Earthworks

The dust emission magnitude classification for earthworks is different for each site in terms of timing, geology, topography and time-scale. Examples of the potential dust emission classes are provided in the guidance as follows;

Large: total site area > 110,000m^2, potentially dusty soil type e.g. clay, greater than 10 heavy earth moving vehicles active at any one time, formation of bunds greater than 6m in height.

Medium: total site area 18,000 to 110,000 m², moderately dusty soil type e.g. silt, 5 to 10 heavy earth moving vehicles active at any one time, formation of bunds 3 to 6m in height.

Small: total sight area less than 18,000 m², soil type with large grain size e.g. sand, less than five heavy earth moving vehicles active at any one time, formation of bunds < 3 meters in height.

Construction

The dust emission magnitude classification for construction is varied for each site in terms of timing, building type, duration, and scale. Examples of the potential dust emissions classes are provided in the guidance as follows:

Large: total building volume > 75,000 m³, piling, on site concrete batching, sandblasting;

Medium: Total building volume 12,000 to 75,000 m³, potentially dusty construction material e.g. on site concrete batching;

Small: total building volume less than 12,000 m³, construction material with low potential for dust release e.g. metal cladding or timber.

Track out

Considerations which determine the dust emission magnitude class of trackout activities are vehicle size, vehicle speed, vehicle number, geology and duration. Examples of the potential dust emissions classes are provided in the guidance as follows;

Large: >50 HDV (>3.5t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m;

Medium: 20-50 HDV (>3.5t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 m – 100 m; and

Small: <20 HDV (>3.5t) outward movements in any one day, surface material with low potential for dust release, unpaved road length <50m.

Step 2B; Defining the sensitivity of the area

The sensitivity of the area is specified for dust soiling, human health and ecosystems. The sensitivity of the area takes into account the following considerations;

- the specific sensitivities of receptors in the area
- the proximity and number of those receptors
- in the case of PM_{10}, the local background concentration; and
- site specific factors, such as weather there are natural shelters such as trees, to reduce the risk of windblown dust.

Appendix Table 9.1.1 has been used to describe the sensitivity of varying types of receptors, dust soiling, health effects and ecological effects.

Appendix Table 9.1.1: Sensitivity of the Locality

Sensitivity	Dust Soiling	Human Receptors	Ecological Receptors
High	• Users can reasonably expect enjoyment of a high level of amenity; or • the appearance, aesthetics or value of their property would be diminished by soiling; and • the people or property would reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. • indicative examples include dwellings, museums and other culturally important collections, medium and long term car parks and car showrooms.	• locations where members of the public are exposed over a period relevant to the air quality objective for PM10 (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). • Indicative examples include residential properties. Hospitals, schools and residential care homes should also be considered as having equal sensitivity to residential areas for the purposes of this assessment.	• locations with an international or national designation and the designated features may be affected by dust soiling; or • locations where there is a community of a particularly dust sensitive species such as vascular species included in the Red Data List For Great Britain. • indicative examples include a Special Area of Conservation (SAC) designated for acid heathlands or a local site designated for lichens adjacent to the demolition of a large site containing concrete (alkali) buildings.
Medium	• users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or • the appearance, aesthetics or value of their property could be diminished by soiling; or • the people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. • indicative examples include parks and places of work.	• locations where the people exposed are workers, and exposure is over a time relevant to the air quality • objective for PM10 (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). • indicative examples include office and shop workers, but will generally not include workers occupationally exposed to PM10, as protection is covered by Health and Safety at Work legislation.	• locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown; or • locations with a national designation where the features may be affected by dust deposition. • indicative example is a Site of Special Scientific Interest (SSSI) with dust sensitive features.
Low	• the enjoyment of amenity would not reasonably be expecteda; or • property would not reasonably be expecteda to be diminished in appearance, aesthetics or value by soiling; or • there is transient	• locations where human exposure is transient. • indicative examples include public footpaths, playing fields, parks and shopping streets.	• locations with a local designation where the features may be affected by dust deposition. • indicative example is a local Nature Reserve with dust sensitive features.

	exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. • indicative examples include playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parksb and roads.		

Regarding the sensitivities assigned of the different types of receptors surrounding the site and numbers of receptors within certain distances of the site, a sensitivity classification for the area can be defined for each. **Appendix Table 9.1.2** to **Appendix Table 9.1.4** indicate the method used to determine the sensitivity of the area for dust soiling, human health and ecological impacts, respectively.

For trackout, as per the guidance, it is only considered necessary consider trackout impacts up to 50m from the edge of the road.

Appendix Table 9.1.2: Sensitivity of the Area to Dust Soiling Effects on People and Property

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		<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

Appendix Table 9.1.3: IAQM 2024 Sensitivity of the area to Human Health

Receptor Sensitivity	Annual Mean PM10 concentration	Number of Receptors	Distance from the Source (m)			
			<20	<50	<100	<250
High	>32 µg/m3 (>18 µg/m3 in Scotland)	>100	High	High	High	Medium
		10-100	High	High	Medium	Low
		1-10	High	Medium	Low	Low
	28-32 µg/m3 (16-18 µg/m3 in Scotland)	>100	High	High	Medium	Low
		10-100	High	Medium	Low	Low
		1-10	High	Medium	Low	Low
	24-28 µg/m3 (14-16 µg/m3 in Scotland)	>100	High	Medium	Low	Low
		10-100	High	Medium	Low	Low
		1-10	Medium	Low	Low	Low
	<24 µg/m3 (<14 µg/m3 in Scotland)	>100	Medium	Low	Low	Low
		10-100	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
Medium	>32 µg/m3 (>18 µg/m3 in Scotland)	>10	High	Medium	Low	Low
		1-10	Medium	Low	Low	Low
	28-32 µg/m3 (16-18 µg/m3 in Scotland)	>10	Medium	Low	Low	Low
		1-10	Low	Low	Low	Low
	24-28 µg/m3 (14-16 µg/m3 in Scotland)	>10	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
	<24 µg/m3 (<14 µg/m3 in Scotland)	>10	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
Low	-	≥1	Low	Low	Low	Low

Appendix Table 9.1.4: IAQM 2024 Sensitivity of the area to Ecological Impacts

Receptor Sensitivity	Distance from the Source (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

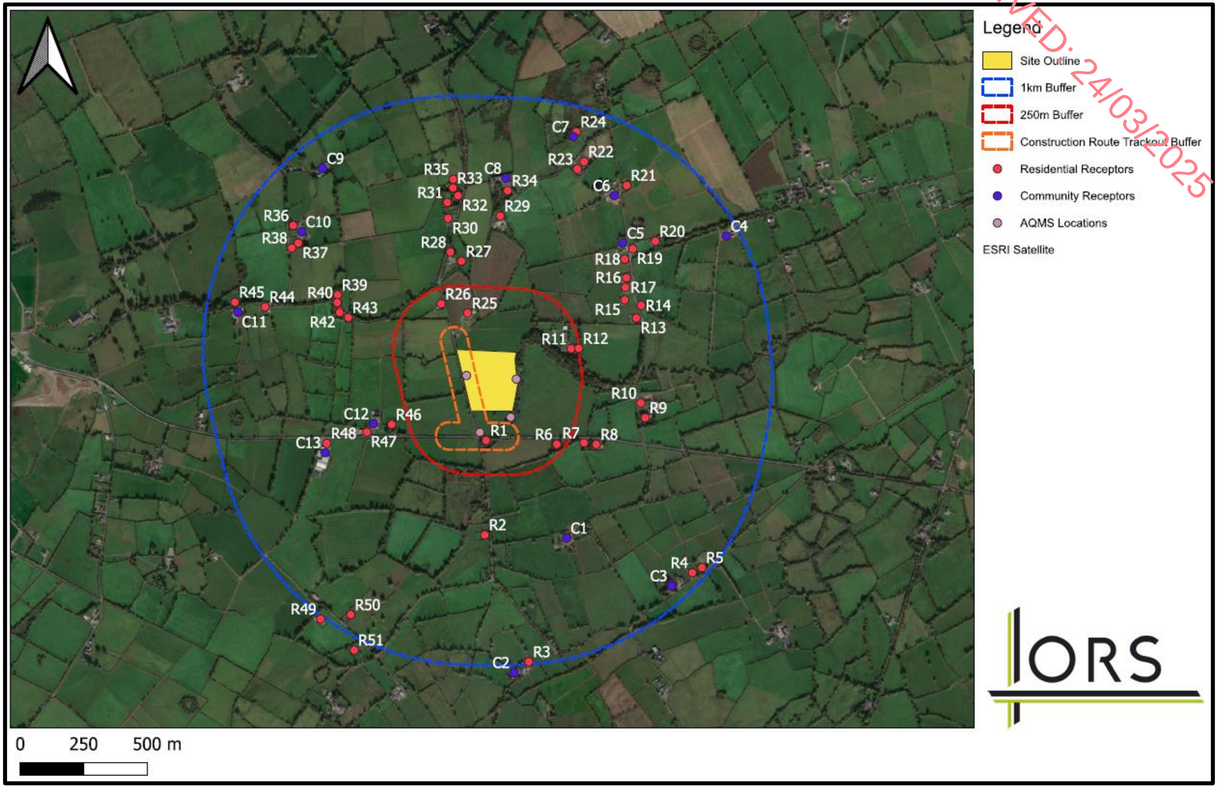
The final step is to use both the dust emission magnitude classification with the sensitivity of the area, to establish a potential risk of effects for each construction activity, before the use of mitigation. **Appendix Table 9.1.5** shows the method used to assign the level of risk for each construction activity.

Appendix Table 9.1.5: IAQM 2024 Risk of Dust Impacts from Earthworks/Construction/Trackout

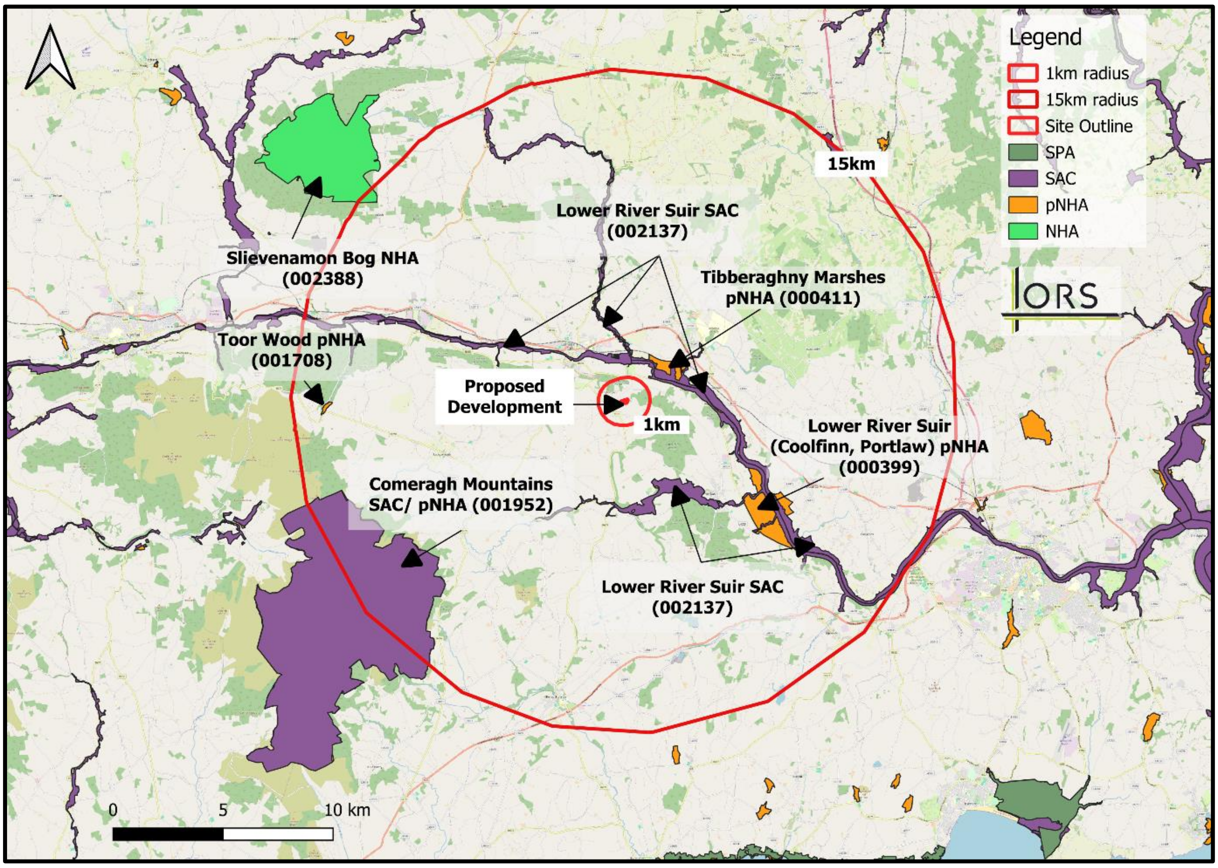
Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

APPENDIX 9.2

Appendix Figure 9.2.1: Receptor and AQMS Locations



Appendix Figure 9.2.2: Designated Site Locations



APPENDIX 9.3

Appendix Table 9.3.1: Onsite Monitoring Gaseous Compounds

AQMS Location Reference	Location Description	Grid Reference (ITM)	NO (µg/m³)	NO_2 (µg/m³)	NOx (µg/m³)	H2S (µg/m³)	NH3 (µg/m³)	SO2 (µg/m³)	CO (mg/m³)	PM10 (µg/m³)	PM/2.5 (µg/m³)
AM01			1.20	1.60	1.60	0.17	4.33	1.52	-	-	-
AM02			1.20	1.40	1.60	0.10	2.60	1.52	-	-	-
AM03			1.20	1.70	1.70	0.23	3.96	1.52	-	-	-
AM04			1.20	1.50	1.60	0.13	3.94	1.52	-	-	-
Birr Monitoring Station	Birr	606121, 704883	-	-	-	-	-	-	0.57	-	-
Tipperary Town Monitoring Station	Tipperary Town	589335, 636442	-	-	-	-	-	-	-	18.28	14.81
		Average	**1.20**	**1.55**	**1.63**	**0.16**	**3.71**	**1.52**	**0.57**	**18.28**	**14.81**
Values at LOD											

Appendix Table 9.3.2: Onsite Sniff Test

Location	Odour Intensity	Odour Persistence	Location Sensitivity	Odour Descriptor
Day 1 Sniff Survey – 21/12/2023				
1	0	0	0	No detectable odour
2	0	0	0	No detectable odour
3	0	0	0	No detectable odour
4	0	0	0	No detectable odour
Day 2 Sniff Survey – 17/01/2024				
1	0	0	0	No detectable odour
2	0	0	0	No detectable odour
3	0	0	0	No detectable odour
4	0	0	0	No detectable odour

APPENDIX 9.4

Defining & 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 & Threshold

The measure of strength of an odour sensation is called odour intensity and is linked to the odour concentration. The minimum concentration of an odorous substance that causes an olfactory sensation is the odour threshold. Odour thresholds are usually defined by an odour panel. Odour threshold is not a precisely defined value as it depends on the odour panellists involved and the method & means of introducing the odour sensation to the panel. Odour detection concerns the minimum odorous substance concentration necessary to observe the presence of the stimulus however an odour recognition threshold concerns the minimum odorous substance concentration necessary to recognise the nature of the stimulus. Typically, the recognition threshold exceeds the detection threshold by a factor of 2 to 10 (Water Environment Federation, 1995).

Odour Character

The nature of an odour characterizes it from another odour of equal intensity. Odours are identified based on odour descriptor terms (e.g. earthy, chemical etc.). Odour character is assessed by contrast with other odours.

Hedonic Tone

Hedonic tone of an odour concerns its pleasantness or unpleasantness. When an odour is assessed in a test house for its hedonic tone in the neutral context of an olfactometric presentation, the panel is exposed to a stimulus of controlled intensity and duration. The degree of pleasantness or unpleasantness is determined by each panel member's experience and associations. The responses among panel members may differ depending on odour nature; an odour pleasant to some may be found highly unpleasant by others.

Relevant Odour Standards

Exposure of the public to a specific odour comprises of two factors; the concentration & the duration that the public may perceive the odour. The recognition threshold is generally 5 OUE/m3 and the ambient concentration at which the odour may be deemed a nuisance is between 5 and 10 OUE/m3 based on hydrogen sulphide (H2S) (Warren Spring Laboratory, 1980).

The recognition threshold is generally about five times this concentration (5 OUE/m^3) and the ambient concentration at which the odour may be considered a nuisance is between 5 and 10 OUE/m^3 based on hydrogen sulphide (H_2S) (Warren Spring Laboratory, 1980). Clarkson and Misslebrook (1991) proposed that a “faint odour” was an acceptable threshold criteria for the assessment of odour as a nuisance. Historically, it has been generally accepted that ambient odour concentrations of between 5 and 10 OUE/m^3 would give rise to a faint odour only, and that only a distinct odour (ambient concentration of >10 OUE/m^3) could give rise to a nuisance (McGovern & Clarkson, 1994). However, this criteria has generally been based on waste water treatment plants where the source of the odour is generally hydrogen sulphide. In 1990, a survey of the populations surrounding 200 industrial odour sources in the Netherlands showed that there were no justifiable complaints when 98%ile compliance with an odour exposure standard of a “faint odour” (5 - 10 OUE/m^3) was achieved (McGovern & Clarkson, 1994).

APPENDIX 9.5

Receptor Results – 75% Scenario

In line with the EPA AG4 Guidance, an additional assessment was undertaken to account for the stacks operating at 75% volume flow.

Input Parameters

Table 9.5.1 details the normalised volume flow (Nm^3/s) for each of the emission points associated with the proposed site, based on the emissions.

Table 9.5.1: Normalised Flow Rates from Stacks

Stack	Actual Volume Flow (m^3/hr)	Normalised Volume Flow (Nm^3/hr)*	Normalised Volume Flow (Nm^3/s)
CHP	5,817	3,506	0.97
Boiler	274	183	0.05

Table 9.5.2 below relates to the emission concentrations values through the flues associated with the CHP unit and gas boiler on the proposed site, based on the expected emission levels detailed in the Table above.

Table 9.5.2: Emission Concentrations

Pollutant	CHP Emission Concentration Values (mg/Nm^3)	Boiler Emission Concentration Values (mg/Nm^3)	Stack Emissions (g/s)	
			CHP Engine (0.97 Nm^3/s)	Boiler (0.05 Nm^3/s)
Oxides of Nitrogen (NOx)	250	93	**0.243**	**0.005**
Carbon Monoxide (CO)	1,000	N/A	**0.974**	**N/A**

Residential Receptor Results

NO_2

NO_2 modelling was carried out for each individual year with the results at the nearest sensitive locations presented in **Table 9.5.3** and **9.5.4** below.

All results are the NO_2 concentration in µg/m³.

Table 9.5.3: Annual Average NO_2 concentrations at nearest residential locations (75% Volume Flow)

Location	2019	2020	2021	2022	2023	Average
R1	0.38	0.37	0.40	0.38	0.42	0.39
R2	0.16	0.19	0.17	0.18	0.19	0.18
R3	0.10	0.14	0.10	0.12	0.12	0.12
R4	0.10	0.13	0.09	0.11	0.11	0.11
R5	0.09	0.12	0.09	0.10	0.11	0.10
R6	0.08	0.11	0.07	0.09	0.10	0.09
R7	0.08	0.11	0.07	0.09	0.09	0.09
R8	0.16	0.16	0.15	0.15	0.17	0.16
R9	0.14	0.14	0.13	0.13	0.15	0.14
R10	0.11	0.12	0.10	0.11	0.12	0.11
R11	0.10	0.11	0.10	0.10	0.11	0.10
R12	0.11	0.12	0.11	0.11	0.12	0.11
R13	0.11	0.12	0.12	0.11	0.12	0.12
R14	0.10	0.10	0.11	0.10	0.11	0.10
R15	0.04	0.05	0.06	0.04	0.05	0.05
R16	0.02	0.03	0.03	0.02	0.03	0.03
R17	0.12	0.10	0.12	0.10	0.09	0.11
R18	0.11	0.12	0.14	0.12	0.11	0.12
R19	0.09	0.12	0.13	0.11	0.09	0.11
R20	0.09	0.13	0.11	0.09	0.11	0.11
R21	0.10	0.12	0.12	0.10	0.12	0.11
R22	0.09	0.11	0.11	0.10	0.11	0.10
R23	0.07	0.08	0.07	0.08	0.09	0.08
R24	0.13	0.21	0.18	0.20	0.20	0.18
R25	0.10	0.13	0.14	0.18	0.19	0.15
R26	0.10	0.13	0.14	0.18	0.18	0.14
R27	0.10	0.12	0.13	0.18	0.17	0.14

Location	2019	2020	2021	2022	2023	Average
R28	0.11	0.09	0.10	0.15	0.12	0.11
R29	0.10	0.09	0.10	0.13	0.11	0.11
R30	0.12	0.13	0.15	0.16	0.14	0.14
R31	0.04	0.05	0.05	0.05	0.05	0.05
R32	0.04	0.04	0.04	0.04	0.05	0.04
R33	0.28	0.22	0.24	0.26	0.25	0.25
R34	0.20	0.17	0.23	0.21	0.18	0.20
R35	0.15	0.14	0.16	0.16	0.13	0.14
R36	0.20	0.17	0.18	0.18	0.15	0.18
R37	0.19	0.16	0.18	0.17	0.14	0.17
R38	0.17	0.14	0.17	0.15	0.13	0.15
R39	0.16	0.13	0.16	0.14	0.14	0.15
R40	0.11	0.09	0.10	0.08	0.08	0.09
R41	0.07	0.10	0.07	0.08	0.09	0.08
C1	0.17	0.20	0.19	0.19	0.20	0.19
C2	0.07	0.10	0.06	0.08	0.08	0.08
C3	0.08	0.10	0.08	0.09	0.10	0.09
C4	0.17	0.16	0.19	0.17	0.14	0.17
C5	0.02	0.03	0.04	0.04	0.03	0.03
C6	0.09	0.12	0.13	0.11	0.09	0.11
C7	0.05	0.06	0.06	0.06	0.07	0.06
C8	0.08	0.13	0.14	0.12	0.13	0.12
C9	0.08	0.09	0.09	0.08	0.11	0.09
C10	0.47	0.34	0.50	0.50	0.47	0.45
C11	0.17	0.14	0.17	0.15	0.13	0.15
C12	0.10	0.09	0.10	0.08	0.08	0.09
C13	0.10	0.08	0.10	0.09	0.07	0.09
C14	0.10	0.09	0.11	0.13	0.11	0.11
Limit	**40**	**40**	**40**	**40**	**40**	**40**

Table 9.5.4 below details the 99.8% of Max 1-Hour NO_2 concentration at each of the sensitive receptors for the MET Data 2019 – 2023.

Table 1: Short Term NO_2 concentrations at nearest residential locations (75% Volume Flow)

Location	99.8% of Max 1-Hour
R1	6.0
R2	3.0
R3	2.6
R4	2.4
R5	2.3
R6	2.3
R7	2.4
R8	2.6
R9	2.4
R10	2.1
R11	2.0
R12	2.1
R13	2.2
R14	2.0
R15	2.9
R16	1.8
R17	2.4
R18	4.6
R19	4.8
R20	5.4
R21	6.3
R22	5.7
R23	4.5
R24	9.4
R25	7.5
R26	7.3
R27	6.7
R28	4.5
R29	4.8
R30	6.3
R31	1.9
R32	1.9
R33	7.0
R34	8.1

R35	6.5
R36	3.9
R37	3.7
R38	3.4
R39	2.2
R40	1.4
R41	2.0
C1	3.1
C2	2.1
C3	1.9
C4	5.5
C5	1.9
C6	4.9
C7	3.1
C8	6.6
C9	4.6
C10	17.0
C11	3.1
C12	1.4
C13	2.1
C14	5.6
Limit	**200**

The results above have assumed that 50% of short term emissions of oxides of nitrogen convert to nitrogen dioxide.

CO

CO modelling was carried out for each individual year with the results at the nearest sensitive location presented in **Table 2** below. All results are the CO concentration in µg/m^3.

Table 2: Max Daily 8-Hour Mean CO concentration at nearest residential locations (75% Volume Flow)

Location	2019	2020	2021	2022	2023	Average
R1	29.4	26.9	36.4	29.7	28.1	30.1
R2	17.5	15.8	20.2	18.2	16.4	17.6
R3	14.8	13.6	11.6	14.6	14.3	13.8

Location	2019	2020	2021	2022	2023	Average
R4	14.0	12.4	10.9	13.6	13.2	12.8
R5	13.2	11.5	11.3	12.7	12.2	12.2
R6	11.3	11.1	10.5	10.3	12.9	11.2
R7	10.5	10.6	10.7	9.4	13.7	11.0
R8	13.5	10.5	18.2	10.5	13.7	13.3
R9	13.1	9.6	16.1	11.3	12.7	12.6
R10	11.4	8.4	12.1	10.9	11.5	10.8
R11	8.2	10.4	9.2	7.5	9.0	8.9
R12	9.1	13.0	9.9	8.0	12.0	10.4
R13	8.5	11.5	9.2	9.5	13.3	10.4
R14	8.5	10.3	8.4	12.1	10.6	10.0
R15	11.4	23.1	17.0	11.7	16.7	16.0
R16	3.7	13.3	14.4	7.4	8.4	9.4
R17	16.4	12.5	12.6	11.7	9.5	12.5
R18	16.4	15.2	20.8	19.4	16.9	17.7
R19	17.1	27.3	29.7	24.5	15.8	22.9
R20	15.8	24.5	18.0	27.5	23.6	21.9
R21	16.5	30.3	25.9	40.6	26.0	27.9
R22	16.4	27.2	22.8	25.9	22.5	23.0
R23	14.1	21.2	14.8	18.6	17.0	17.1
R24	34.2	81.3	51.0	57.0	58.0	56.3
R25	41.0	44.6	39.8	47.5	45.2	43.6
R26	30.7	37.1	33.8	45.5	30.1	35.4
R27	18.1	28.3	25.2	42.6	30.1	28.9
R28	24.6	15.3	24.8	27.3	22.5	22.9
R29	19.5	19.5	22.6	21.4	27.6	22.1
R30	23.3	22.6	31.6	37.2	26.3	28.2
R31	9.0	10.4	19.2	7.9	17.3	12.8
R32	12.2	9.8	10.7	13.6	10.2	11.3
R33	32.2	23.3	39.1	37.7	42.0	34.9
R34	29.3	21.8	29.6	52.4	42.3	35.1
R35	30.5	23.3	24.8	28.3	18.6	25.1
R36	21.5	17.2	25.1	15.3	12.0	18.2
R37	20.5	19.6	17.2	15.6	10.1	16.6

Location	2019	2020	2021	2022	2023	Average
R38	21.8	18.8	16.4	15.3	13.6	17.2
R39	9.3	10.1	12.9	10.0	10.6	10.6
R40	6.7	7.6	9.0	8.8	6.5	7.7
R41	11.0	9.2	12.0	9.9	11.6	10.7
C1	15.9	17.0	19.4	17.0	17.5	17.4
C2	9.4	9.0	10.7	8.4	12.7	10.0
C3	11.0	9.9	8.7	11.0	10.5	10.2
C4	28.2	25.9	40.2	30.6	35.1	32.0
C5	5.5	9.8	12.7	9.0	6.6	8.7
C6	15.0	31.7	31.8	22.0	14.7	23.0
C7	22.1	13.9	10.1	11.6	11.4	13.8
C8	14.0	52.9	56.3	48.9	30.6	40.5
C9	30.9	20.6	24.5	24.3	27.7	25.6
C10	75.1	54.7	69.5	101.5	98.7	79.9
C11	13.8	17.0	15.5	12.4	15.6	14.9
C12	6.3	7.2	8.6	8.3	6.2	7.3
C13	13.1	10.7	10.1	10.2	7.6	10.3
C14	36.2	20.4	21.2	38.8	24.5	28.2
Limit	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**

The predicted ground level CO concentrations in each year, as well as the 5-year average are significantly below the limit values.

ECOLOGICAL RESULTS

Modelling was undertaken to confirm the emissions from the site layout, the results of which are provided in the Table below.

Table 9.5.6: Annual Average NO_x Concentrations at Ecologically Sensitive Locations (75% Volume Flow)

Location	2019	2020	2021	2022	2023	Average
E1	0.047	0.065	0.049	0.054	0.060	0.055
E2	0.005	0.006	0.005	0.005	0.006	0.005
E3	0.001	0.001	0.001	0.001	0.001	0.001
E4	0.002	0.002	0.002	0.002	0.002	0.002

All of the predicted Ground Level Concentrations of NO_x detailed in the Tables above are significantly below the limit values as provided in **Table 9.1** in relation to the protection of vegetation.