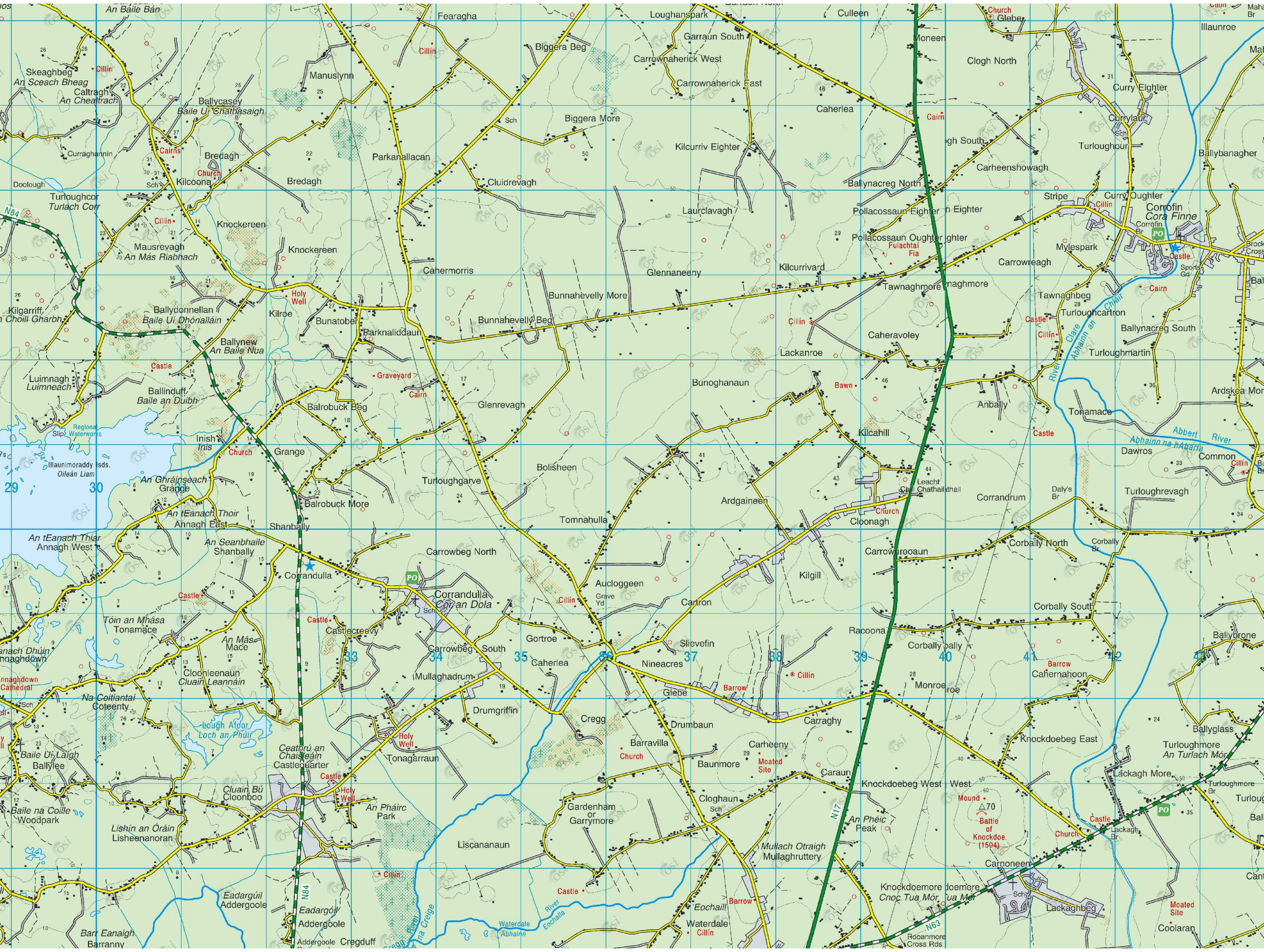
CHAPTER 10

AIR QUALITY



QUARRY CONSULTING

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CHAPTER 10: AIR QUALITY

Introduction

10.1 This report assesses the likely air quality impacts associated with the operation of proposed continuation of use and lateral extension to a quarry at Ardgaineen, Claregalway, Co. Galway.

10.2 This report was prepared by Aisling Cashell. Aisling is an Environmental Consultant in the Air Quality & Climate section of AWN Consulting. She holds a BA and MAI in Civil, Structural and Environmental Engineering from Trinity College Dublin. She is a Member of the Institute of Engineers Ireland (MIEI). She has two years of experience in undertaking air quality and climate assessments. She has prepared air quality and climate impact assessments as part of EIARs for residential, commercial and industrial developments, as well as renewable energy developments. She has undertaken air quality and climate impact assessments for transportation schemes, primarily regional and national road schemes, from constraints, through to route selection and EIAR stage.

10.3 This report was reviewed by Dr. Jovanna Arndt, a Principal Environmental Consultant in the Air Quality & Climate section of AWN Consulting. She holds a BSc. in Environmental Science and a Ph.D. in Atmospheric Chemistry from University College Cork. She is an Associate Member of both the Institute of Air Quality Management and the Institute of Environmental Sciences. She has been specialising in the area of air quality and climate over 8 years and has prepared air quality and climate assessments for inclusion within EIARs for residential developments such as Twenties Lane (Planning Application Ref: 22713), Cherrywood T13 (Planning Application Ref: DZ23A/0028), Corballis Donabate LRD (Planning Application Ref: LRD0017/S3), commercial and industrial developments by Dublin Airport Authority, Zoetis, Ipsen, Merck Millipore, Greener Ideas Limited and Abbvie, as well as renewable energy developments such as Codling Wind Park and the Cúil Na Móna Anaerobic Digestion Facility. She also specialises in assessing air quality impacts using air dispersion modelling of transportation schemes such as BusConnects Dublin, major Highways England Road schemes and major rail infrastructure in the form of High Speed 2 (HS2 in the UK). She has prepared air dispersion modelling assessments of emissions from data centres, energy centres and the chemical industry as part of EPA Industrial Emissions Licences for Microsoft, Greener Ideas Limited, Merck Millipore, Lilly Limerick, Chemifloc, Takeda, Kingspan and Kilshane Energy. She has also provided Air Quality Action Plan (AQAP) and Air Quality Management Area (AQMA) support to several UK councils and assessed the air quality impacts of potential Clean Air Zones in the UK.

Legislative and Policy Context

10.4 The principal guidance and best practice documents used to inform the assessment of potential impacts on air quality are summarised below.

- PE-ENV-01106: Air Quality Assessment of Specified Infrastructure Projects (Transport Infrastructure Ireland [TII], 2022);
- Air Dispersion Modelling from Industrial Installations Guidance Note (AG4) (EPA, 2020); and

- Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition (Periodically Updated) (USEPA, 1986).

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

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

Assessment Methodology and Significance Criteria

Criteria for Rating of Impacts

10.6 The rating of potential environmental effects of the development on air quality is based on the criteria presented in Table 3.3 of the EPA (2022) document titled *Guidelines on the Information to Be Contained in Environmental Impact Assessment Reports*. These criteria consider the quality, significance, duration and types of effect characteristics identified.

Ambient Air Quality Standards

10.7 National and European statutory bodies, the Department of the Environment, Heritage and Local Government in Ireland and the European Parliament and Council of the European Union, have set limit values in ambient air for a range of air pollutants to reduce the risk to health from poor air quality. These limit values or *"Air Quality Standards"* are health or environmental-based levels for which additional factors may be considered. For example, natural background levels, environmental conditions and socio-economic factors may all play a part in the limit value which is set.

10.8 Air quality significance criteria are assessed on the basis of compliance with the appropriate standards or limit values. The applicable standards in Ireland are set out in Directive (EU) 2024/2881 *of the European Parliament and of the Council of 23 October 2024 on ambient air quality and cleaner air for Europe (recast)*. This directive supersedes EU Directive 2008/50/EC *of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe* (CAFE Directive). It sets out new air quality standards for pollutants to be reached by 2030 which are more closely aligned with the World Health Organisation (WHO) air quality guidelines.

10.9 The Ambient Air Quality Standards Regulations 2022 (S.I. 739 of 2022) (the Air Quality Standards Regulations 2022) further transposed the CAFE Directive and revoked the Air Quality Standards Regulations 2011, as amended. With the adoption of Directive (EU) 2024/2881, Ireland must transpose this directive into national law, i.e. update the Air Quality Standards Regulations, before December 2026.

10.10 The ambient air quality standards applicable for dust deposition and particulate matter (as PM_{10} and $PM_{2.5}$) are outlined in Table 0.1. The limit values set out in Directive (EU) 2024/2881 will need to be achieved by 2030, with the limit values set out in the Air Quality Standards Regulations 2022, and future updated regulations, applicable until 2030.

Table 0.1: Air Quality Standards

Pollutant	Directive 2008/50/EC		Directive (EU) 2024/2881	
	Limit Type	Limit Value (applicable until 2030)	Limit Type	Limit Value (attained by 2030)
Dust Deposition	TA Luft (German VDI 2002)	Annual average limit for nuisance dust	350 mg/m^2/day	
Particulate Matter (as PM_{10})	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 µg/m^3	24-hour limit for protection of human health - not to be exceeded more than 18 times/year	45 µg/m^3
	Annual limit for protection of human health	40 µg/m^3	Annual limit for protection of human health	20 µg/m^3
Particulate Matter (as $PM_{2.5}$)	N/A	N/A	24-hour limit for protection of human health - not to be exceeded more than 18 times/year	25 µg/m^3
	Annual limit for protection of human health	25 µg/m^3	Annual limit for protection of human health	10 µg/m^3

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

10.11 In April 2023, the Government of Ireland published the *Clean Air Strategy for Ireland* (Government of Ireland, 2023), which provides a high-level strategic policy framework needed to reduce air pollution. The strategy commits Ireland to achieving the 2021 World Health Organisation (WHO) Air Quality Guidelines Interim Target 3 (IT3) by 2026, the IT4 targets by 2030 and the final targets by 2040 (Table 10.2). The strategy notes that a significant number of Environmental Protection Agency (EPA) monitoring stations observed air pollution levels in 2021 above the WHO targets; 80% of these stations would fail to meet the final $PM_{2.5}$ target of 5 µg/m^3. The strategy also acknowledges that *"meeting the WHO targets will be challenging and will require legislative and societal change, especially with regard to both $PM_{2.5}$ and NO_2"*. Ireland will revise its air quality legislation in line with the proposed EU revisions to the EU 2008/50/EC – Clean Air For Europe (CAFE) Directive, which will set interim 2030 air quality standards and align the EU more closely with the WHO targets.

Table 10.2 WHO Air Quality Guidelines

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

Dispersion Modelling Methodology

10.12 The methodology used as part of this assessment involved undertaking a desk-based study to examine all relevant information relating to air quality conditions in the vicinity of the application site.

10.13 The air quality assessment has been carried out following procedures described in the publications by the EPA (EPA, 2015; 2020; 2022) and using the methodology outlined in the guidance documents published by the USEPA (USEPA, 2017; 2021). The air dispersion modelling input data consisted of information on the physical environment, design details from all emission sources on-site and five full years of meteorological data. Using this input data, the model predicted ambient ground level concentrations and deposition rates beyond the land ownership boundary for each hour of the modelled meteorological years. The model post-processed the data to identify the location and maximum of the worst-case ground level concentration. This worst-case concentration and deposition rate was then added to the background concentration and deposition rate to give the worst-case predicted environmental concentration (PEC) and deposition flux. The PEC was then compared with the relevant ambient air quality standard to assess the significance of the releases from the site.

10.14 Air dispersion modelling was undertaken to assess the dust deposition flux at the land ownership boundary, and the PM_{10} and $PM_{2.5}$ concentrations associated with the activities at sensitive locations beyond the land ownership boundary. Modelling using the United States Environmental Protection Agency (USEPA) new generation dispersion model AERMOD (USEPA, 2021) (Version 24142) was used as recommended by the USEPA (2017) and Irish EPA (2020). The steady-state Gaussian plume model is used to assess pollutant concentrations associated with industrial sources. The model has been designated the regulatory model by the USEPA for modelling emissions from industrial sources in both flat and rolling terrain (USEPA, 2017). The AERMET meteorological pre-processor (USEPA, 2018) was used to generate hourly boundary layer parameters for use by AERMOD. Dust generation rates were calculated from factors derived from empirical assessment and detailed in the USEPA database entitled *Compilation of Air Pollution Emission Factors*, Volume 2, AP-42 (1986, updated periodically) (USEPA, 1986). The emission factors have been presented in Appendix 2.

Process Emissions

10.15 Screening and crushing activities typically emit dust. Dust is characterised as encompassing particulate matter with a particle size of between 1 and 75 microns (1 – 75 µm). Deposition typically occurs in close proximity to each site and potential impacts generally occur within 500 metres of the dust generating activity as dust particles fall out of suspension in the air. Larger particles deposit closer to the generating source and deposition rates will decrease with distance from the source. Sensitivity to dust depends on the duration of the dust deposition, the dust generating activity, and the nature of the deposit. Therefore, a higher tolerance of dust deposition is likely if only short periods of dust deposition are expected and the dust generating activity is either expected to stop or move on.

10.16 The potential for dust to be emitted will depend on the type of activity being carried out in conjunction with environmental factors including levels of rainfall, wind speed, wind direction and dust prevention measures in place. This assessment identifies and quantifies the dust sources from the site.

10.17 The quarry facility at Ardgaineen, Claregalway, Co. Galway is an active quarry operating within an existing permitted area. The proposed development comprises a c.6.1-ha lateral extension to the existing quarry within an overall application area of c.12 ha. It provides for rock extraction to a final floor level of 4 mOD; The production levels of quarry activities will remain consistent. However, the fixed near-surface processing, including primary and secondary crushing and screening, will be relocated to the quarry floor. The tertiary crushing and screening processes will continue at their current near-surface location. This proposal is designed to maintain production intensity while extending the quarry's operational lifespan. Extraction will continue with monthly blasting. For the purposes of this assessment an estimate of 13 truck movements in and out of the site per hour has been assumed, based on an average of 170 vehicle loads per day total. Loading onto trucks for distribution will occur at the storage area.

10.18 The annual tonnage of limestone processed will be up to a maximum of 400,000 tonnes, which will be drilled and blasted, then screened, crushed, and exported offsite. Approximately 61,000 m³ of overburden will be removed; this material will be used to form screening berms, stored in the designated overburden area, or exported off-site as required. The permitted hours of operation at the site are Monday to Friday 07:00 to 20:00 and Saturdays 08:00 to 16:00. Operations are closed on Sundays and Bank Holidays except in emergency situations. These hours have been used for the purpose of the assessment.

The following operations are the main dust generating sources or activities at the site:

- Topsoil/subsoil removal of proposed extension area;
- Compacting of material;

- Movement of empty trucks along paved public roads;
- Movement of empty trucks along unpaved haul roads;
- Extraction of material;
- Crushing of material;
- Screening of material;
- Transfer of material along conveyors;
- Stockpiling of material;
- Loading of material;
- Blasting of material;
- Movement of full trucks along unpaved haul roads;
- Movement of full trucks along paved public roads; and
- Wind erosion at dump areas, stockpiles and exposed surface.

10.19 The formulae and emission rates for the onsite activities are outlined in Appendix 2.

Dust Generation Rates

10.20 Dust generation rates depend on the site activity, particle size, the moisture content of the material and weather conditions. Dust emissions are dramatically reduced where rainfall has occurred due to the cohesion created between dust particles and water and the removal of suspended dust from the air. It is typical to assume no dust is generated under "wet day" conditions where more than 0.2mm of precipitation has occurred.

10.21 Large particle sizes (greater than 75 microns) fall rapidly out of atmospheric suspension and are subsequently deposited in close proximity to the source. Particle sizes of less than 75 microns are of interest as they can remain airborne for greater distances and give rise to the potential dust nuisance at the sensitive receptors. This size range would broadly be described as silt. Emission rates are normally predicted on a site-specific particle size distribution for each dust emission source. In the absence of such information, the particle size distribution outlined in *AP-42 Appendix B.2.2 for Category 3 (mechanically generated aggregate)* (USEPA, 1986) has been used and is outlined in Table 0.3.

Table 0.3 Category 3 Mechanically Generated Aggregates

Cumulative % ≤ Stated Size	Particle Size (µm)	Minimum Value	Maximum Value	Standard Deviation
4	1.0	-	-	-
11	2.0	-	-	-
15	2.5	3	35	7
18	3.0	-	-	-
25	4.0	-	-	-
30	5.0	-	-	-

34	6.0	15	65	13
51	10.0	23	81	14

Source AP-42 (USEPA, 1986)

10.22 Dust deposition typically occurs in close proximity to the dust-generating source. There are a small number of sensitive locations in proximity to the site which can be affected by dust deposition. The site is in an area with a relatively low population density. Most residential dwellings are in ribbon development along the local surrounding roads. The nearest dwellings are located within 15m to the southeast of the boundary of the site. Generally, the potential for severe dust impacts is greatest within 100m of dust generating activities, though residual impacts can occur for distances beyond 100m.

10.23 A receptor grid was created at which concentrations would be modelled. The receptor grid was based on a Cartesian grid with the site at the centre. The inner grid measured 1km x 1km with the site at the centre and concentrations calculated at 50m intervals. The middle grid measured 3km x 3km with the site at the centre and with concentrations calculated at 100m intervals. The outer grid measured 10km x 10km with the site at the centre and with concentrations calculated at 200m intervals. Boundary receptor locations were also placed along the land ownership and site boundary of the site, at 100m intervals. Nearby sensitive residential properties were also added to the model as discrete receptors giving a total of 4,413 calculation points for the model. The modelling has investigated the deposition and concentrations of dust, PM_{10} and $PM_{2.5}$ for the activities outlined above.

Road Traffic

10.24 There is the potential for emissions from road vehicles accessing the site to impact air quality. Pollutants such as NO_2, PM_{10}, $PM_{2.5}$ and CO_2 are emitted from road vehicles.

10.25 The TII guidance *Air Quality Assessment of Specified Infrastructure Projects – PE-ENV-01106* (TII, 2022), states that road links meeting one or more of the following criteria can be defined as being 'affected' by a proposed development and should be included in the local air quality assessment. While the guidance is specific to infrastructure projects, the approach can be applied to any development that causes a change in traffic.

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

10.26 If any of the road links impacts by a proposed development meet any of the above criteria, then a detailed assessment is required.

10.27 The above scoping criteria for both air quality have been used in the current assessment to determine whether the impacted road links require modelling. It was found that the traffic changes associated with the proposed development were significantly below the air quality assessment criteria outlined above. A detailed modelling assessment was not required as impacts to air quality as a result of traffic emissions are predicted to be imperceptible.

Baseline Conditions

10.28 The subject site is Ardgaineen limestone site in Ardgaineen, Claregalway, Co. Galway. The site is an active limestone quarry. The proposed development comprises a c.6.1-ha lateral extension to the existing quarry within an overall application area of c.12 ha. It provides for rock extraction to a final floor level of 4 mOD; no new processing plant is proposed, and crushing, screening and washing will continue within the existing permitted processing areas with no change to the nature of current operations.

Meteorological Conditions

10.29 Meteorological conditions significantly affect the level of dust emissions and subsequent deposition downwind of the source. The most significant meteorological elements affecting dust deposition are rainfall and wind-speed. High levels of moisture, either retained in soil or as a result of rainfall, help to suppress the generation of dust due to the cohesive nature of water between dust particles. Rain also assists in removing dust from the atmosphere through washout. Wind can lift particles up into the air and transport the dust downwind as well as drying out the surface. The worst dust deposition conditions typically occur, therefore, during dry conditions with strong winds.

10.30 The most representative Met Éireann synoptic station to the site is at Athenry, which is approximately 17 km southeast of the site.

10.31 Dust emissions are dramatically reduced where rainfall has occurred due to the cohesion between dust particles and water and the removal of suspended dust from the air. It is typical to assume no dust is generated under “wet day” conditions where rainfall greater than 0.2 mm has fallen. Long-term average meteorological data (1991-2020) from Shannon Airport meteorological station (the closest meteorological station with 30-year data) (Met Éireann, 2025) identified that typically 223 days per annum are “wet”. Thus, approximately 61% of the time no significant dust generation will be likely due to meteorological conditions.

10.32 Wind frequency is also important as dust can only be dispersed by winds, and deposition of dust is a simple function of particle size, wind speed and distance. The closer the source of dust is to a receptor, the higher the potential risk of impact of dust blow. The prevailing winds in the area are westerly to south-westerly, thereby predominantly dispersing any potential dust emissions to the north-east and east of the site (Figure 0.1). Wind speeds averaged 4.6 m/s over the period 1991 - 2020.

10.33 All meteorological data referenced within this assessment is provided by Met Éireann (Met Éireann, 2025). The air dispersion modelling assessment has been conducted for five meteorological years (2020 – 2024) using meteorological data from Athenry meteorological station as per the EPA guidance (2020a).

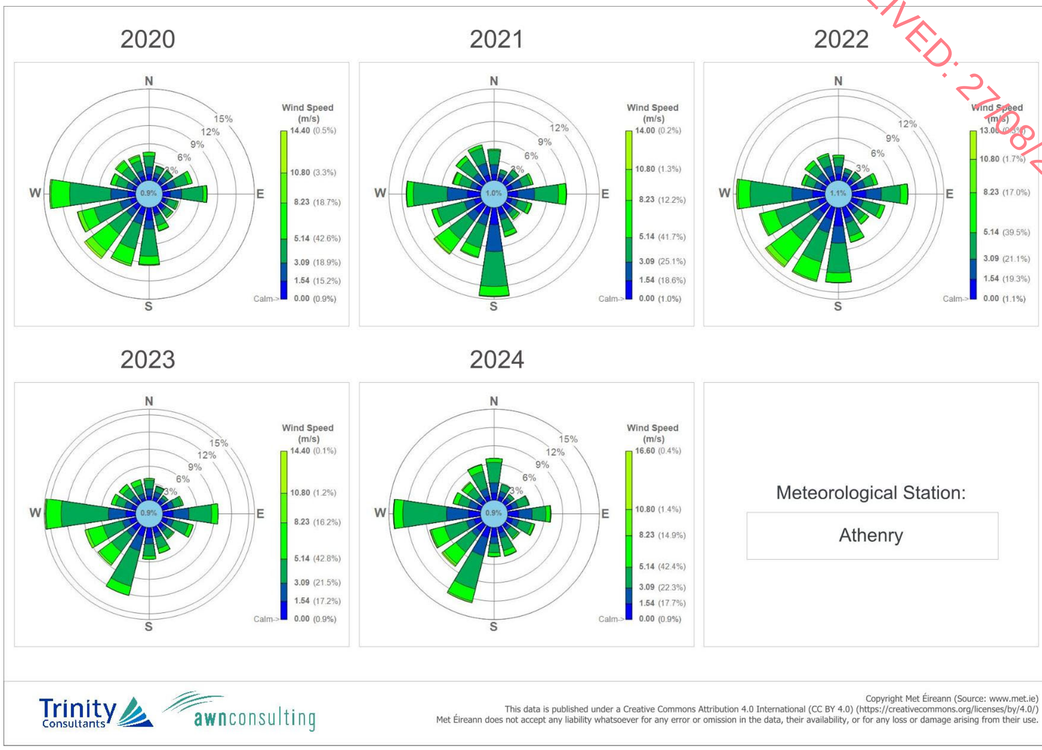

Figure 0.1 Athenry Windroses

Background Sources of Dust

10.34 The sources of dust arising from the site contribute to background levels of dust. Dust is present naturally in the air from a variety of sources (weathering of minerals, wind pick-up across bare ground, fires, etc.). A study by the UK ODPM (UK ODPM, 2000) gives estimates of likely dust deposition levels in specific types of environments. In open country a level of 39 mg/m^2/day is typical, rising to 59 mg/m^2/day on the outskirts of town and peaking at 127 mg/m^2/day for a purely industrial area.

10.35 Ambient dust deposition around the site has been monitored monthly at four perimeter gauges (GD1–GD4) since 2023. Results demonstrate that local ambient deposition is typically in the tens to a few hundred mg/m^2/day, with occasional higher monthly values:

- 2023: site-wide mean ~72 mg/m^2/day (median ~55; range <10–318). No monthly result exceeded the guideline limit of 350 mg/m^2/day.
- 2024: site-wide mean ~234 mg/m^2/day (median ~182; range 21–1532). Six monthly exceedances of 350 mg/m^2/day occurred: GD1 (Mar, Aug, Nov), GD2 (Aug) and GD3 (Apr, Jun).
- 2025 (Q1 data available): mean ~106 mg/m^2/day (median ~104; range 10–243). No exceedances recorded to date.

10.36 These monitored data provide the most representative local baseline for assessment. The monitored medians indicate typical local ambient conditions of ~55 mg/m²/day (2023), ~182 mg/m²/day (2024) and ~104 mg/m²/day (Q1 2025) across the gauges. The assessment baseline is therefore taken from the recent on-site monitoring record, with the statutory/guideline limit value of 350 mg/m²/day applied on a per-gauge, per-month basis.

10.37 For PEC calculations presented later in this chapter, a conservative background of 150 mg/m²/day is used (derived from the least-impacted gauge GD4 2024 annual mean of ~147 mg/m²/day). As on-site gauges can include some quarry influence, using GD4 as background is conservative and may over-estimate true off-site background.

Background Sources of PM_{10} and $PM_{2.5}$

10.38 Monitoring for PM_{10} and $PM_{2.5}$ is carried out by the EPA and Local Authorities at a range of locations throughout Ireland. The details of the monitoring are published in annual reports. The most recent annual monitoring report is *Air Quality in Ireland 2023* (EPA, 2024). Four air quality zones have been defined in Ireland for air quality management and assessment purposes (EPA, 2023). Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 23 towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000, is defined as Zone D. In terms of air monitoring and assessment, the proposed development is within Zone D.

10.39 Long-term PM_{10} monitoring was carried out at the Zone D locations of Claremorris and Kilkit from 2019 to 2023 (EPA, 2024). Annual mean concentrations of PM_{10} range from 7 – 11 µg/m^3 over the five-year period (Table 0.1). Long term average concentrations are below the annual average limit of 40 µg/m^3. Based on the above information a conservative annual mean background concentration of 8 µg/m^3 has been used in this assessment.

10.40 In relation to the maximum 24-hour averaging period (as a 90.4th%ile), a value of 15 µg/m^3 was employed using the methodology outlined in Appendix E of AG4 (EPA, 2020) based on the long-term PM_{10} monitoring was carried out at Zone D locations over the period 2019 – 2023.

Table 0.1 Trends in Zone D Air Quality – PM_{10} ($\mu g/m^3$)

Station	Averaging Period	Year				
		2019	2020	2021	2022	2023
Claremorris	Annual Mean PM_{10} ($\mu g/m^3$)	11	10	8	8	8
	24-hr Mean PM_{10} (as 90.4th%ile) ($\mu g/m^3$)	20	16	13	13	-
	24-hr Mean > 50 µg/m3	0	0	0	0	0
Kilkit	Annual Mean PM_{10} ($\mu g/m^3$)	7	-	-	9	7
	24-hr Mean PM_{10} (as 90.4th%ile) ($\mu g/m^3$)	13	14	-	14	-
	24-hr Mean > 50 $\mu g/m^3$	1	-	-	0	0

10.41 The results of $PM_{2.5}$ monitoring at the Zone D location Claremorris over the period 2019 – 2023 (Table 0.2) (EPA, 2023). Based on this information, the predicted environmental concentration in terms of $PM_{2.5}$ is 6 $\mu g/m^3$.

Table 0.2 Trends in Zone D Air Quality -$PM_{2.5}$ ($\mu g/m^3$)

Station	Averaging Period	Year				
		2019	2020	2021	2022	2023
Claremorris	Annual Mean $PM_{2.5}$ ($\mu g/m^3$)	4	5	8	6	5

10.42 In relation to the annual averages, the ambient background concentration is added directly to the process concentration. However, in relation to the short-term peak concentration, concentrations due to emissions from elevated sources cannot be combined in the same way. Guidance from the UK DEFRA (UK DEFRA, 2022) and the EPA (EPA, 2020) advises that for PM_{10} an estimate of the maximum combined pollutant concentration can be obtained as below:

10.43 PM_{10} – The 90.4th%ile of total 24-hour mean PM_{10} is equal to the maximum of either A or B below:

a) 90.4th%ile of 24-hour mean background PM_{10} + annual mean process contribution PM_{10}.

b) 90.4th%ile 24-hour mean process contribution PM_{10} + annual mean background PM_{10}.

On-site PM_{10} baseline (24 June – 07 July 2025)

10.44 A fully-automated Dustsens DM30 particulate monitor was in operation at the quarry for 14 consecutive days. The air quality monitor was located to the north of the quarry site adjacent to the quarry boundary.

10.45 Daily-mean PM_{10} concentrations (see Appendix 4) ranged from 3.1 µg m³ to 22.5 µg m³, with a monitoring-period mean of 8.2 $\mu g\ m^{-3}$.

10.46 The on-site mean corroborates the Zone D long-term background value of 8 µg m³ already adopted in this chapter, indicating that the regional dataset used for dispersion modelling is representative of current conditions. There were no daily exceedances of the EU 24-hour limit of 50 µg m³, with daily concentrations significantly below this value.

10.47 Monitored $PM_{2.5}$ values averaged 2.5 µg m³ over the monitoring period, well below both the current national annual limit (25 µg m³) and the 2030 target (10 µg m³). The use of the Zone D background $PM_{2.5}$ concentration is considered conservative for the purposes of the modelling assessment.

Potential Effects

Construction Phase

10.48 The proposed development will include minor work associated with the extension. Any dust emissions generated during preparatory works, such as minor internal adjustments or maintenance to existing infrastructure, are expected to be limited and temporary. Construction dust emissions are not predicted to have a significant impact on local air quality.

10.49 The removal of approximately 61,000 m³ of overburden will occur progressively alongside limestone extraction; therefore, its potential effects are assessed within the Operational Phase.

Operational Phase

10.50 The main potential sources of emissions to air will be associated with plant and machinery undertaking day to day activities such as extraction, onsite processing and transportation of material and dust blow generated during dry, windy conditions. Potential impacts associated with day-to-day activities have been separated into dust deposition and vehicle and plant emissions. The assessment is based on the proposed increased traffic volume of 170 truckloads per day.

Dust Deposition

10.51 Based on a background dust deposition of 150 mg/m^2/day in the region of the site, the combined background and process contribution dust deposition level (i.e. predicted environmental concentration (PEC)) peaks at 235.2 mg/m^2/day which is 67% of the TA Luft Limit Value of 350 mg/m^2/day. Figure 0.1 shows the geographical variation in annual dust deposition levels in the region of development. The primary source of dust deposition is attributed to the paved road area, followed by screening and crushing activities.

10.52 The dust deposition level decreases with increasing distance from the site. The worst-case dust deposition at the closest sensitive receptor to the site peaks at 23.4 mg/m^2/day or 6.7% of the TA Luft limit value, excluding background concentrations.

10.53 The impact of dust deposition is considered ***direct***, ***slight, negative, localised*** and ***long-term***.

Table 0.1 Proposed Operations – Dispersion Model Results for TSP

Pollutant / Year	Averaging Period	Worst Case Receptor		Concentrations ($g/m^2/day$)				PEC as % of Limit
		Type	X,Y (UTM Zone 29 N)	PC	Back-ground	PEC	Limit Value	
Dust / 2020	Annual Mean	Boundary	504861, 5917547	75.3	150	225.3	350	64%
Dust / 2021	Annual Mean	Boundary	504861, 5917547	85.2	150	235.2	350	67%
Dust / 2022	Annual Mean	Boundary	504861, 5917547	81.2	150	231.2	350	66%
Dust / 2023	Annual Mean	Boundary	504861, 5917547	76.3	150	226.3	350	65%
Dust / 2024	Annual Mean	Boundary	504861, 5917547	81.7	150	231.7	350	66%

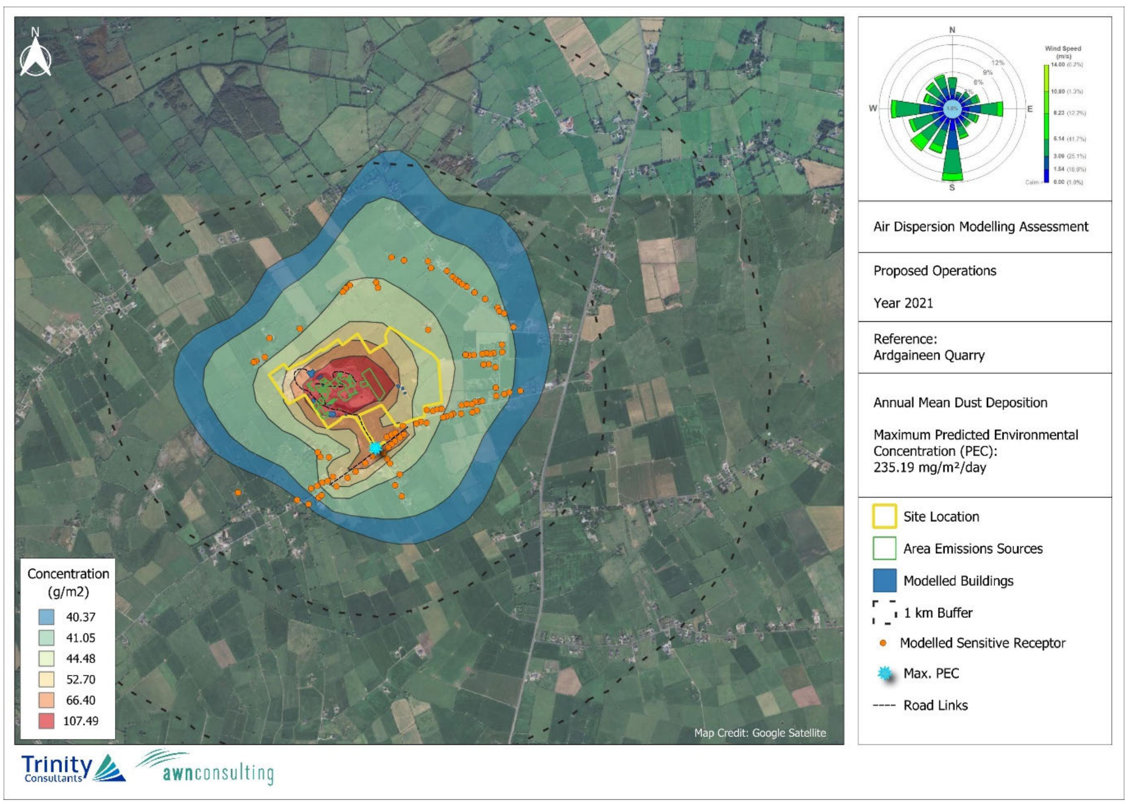

Figure 0.1 Annual Mean Dust Deposition Rate ($g/m^2/yr$) – Proposed Operations

PM_{10}

10.54 Predicted PM_{10} concentrations are significantly lower than the ambient air quality standards at the worst-case residential receptor due to background concentrations and emissions from the proposed development. For emissions from the proposed development the predicted 24-hour and annual mean concentrations (excluding background, i.e. process contribution (PC)) at the worst-case receptor peak at 15.7 µg/m^3 (14% of the PM_{10} annual mean limit value) and 5.9 µg/m^3 (14% of the PM_{10} annual mean limit value) respectively.

10.55 Based on an annual mean background PM_{10} concentration of 8 µg/m^3 in the region of the proposed development, the combined annual PM_{10} concentration including the site, (i.e. predicted environmental concentration (PEC)), peaks at 13.9 µg/m^3 (Table 0.2). This predicted level equates to at most 35% of the annual limit value of 40 µg/m^3.

10.56 Based on a 24hr (90.4th%ile) mean concentration of 15 µg/m^3, the predicted 24-hour PM_{10} concentration (including background) peaks at 23.7 µg/m^3 which is 47% of the 24-hour limit value of 50 µg/m^3 (measured as a 90.4th%ile).

10.57 The geographical variation in the 24-hour mean (90.4th%ile) PM_{10} ground level concentrations are illustrated as concentration contours in Figure 0.2. The geographical variation in annual PM_{10} ground level concentrations in the region of the development are illustrated as contours in Figure 0.3. The locations of the maximum concentrations for PM_{10} are close to the boundary of the site with concentrations decreasing with distance from the facility.

10.58 The dust deposition level decreases with increasing distance from the site. The worst-case dust deposition at the closest sensitive receptor to the site peaks at 5.9 mg/m^2/day or 14.7% of the TA Luft limit value, including background concentrations.

10.59 The impact of PM_{10} is considered direct, slight, negative, localised and long-term.

Table 0.2 Proposed Operations – Dispersion Model Results for PM_{10}

Pollutant / Year	Averaging Period	Worst Case Receptor		Concentrations (µg/m^3)				PEC as % of Limit
		Type	X,Y (UTM Zone 29 N)	PC	Back-ground	PEC	Limit Value	
PM_{10} / 2020	Annual Mean	Sensitive	504876, 5918519	4.9	8	12.9	40	32%
	24-hr Mean (as 90.4th%ile)	Discrete	504876, 5918519	13.6	15	21.6	50	43%
PM_{10} / 2021	Annual Mean	Sensitive	504664, 5918493	5.9	8	13.9	40	35%
	24-hr Mean (as 90.4th%ile)	Discrete	504664, 5918494	15.7	15	23.7	50	47%
PM_{10} / 2022	Annual Mean	Sensitive	504876, 5918519	5.8	8	13.8	40	35%
	24-hr Mean (as 90.4th%ile)	Discrete	504681, 5918515	15.2	15	23.2	50	46%
PM_{10} / 2023	Annual Mean	Sensitive	504982, 5917638	4.9	8	12.9	40	32%
	24-hr Mean (as 90.4th%ile)	Discrete	504511, 5917522	13.3	15	21.3	50	43%
PM_{10} / 2024	Annual Mean	Sensitive	504579, 5917491	5.5	8	13.5	40	34%

Pollutant / Year	Averaging Period	Worst Case Receptor		Concentrations (µg/m^3)				PEC as % of Limit
		Type	X,Y (UTM Zone 29 N)	PC	Back-ground	PEC	Limit Value	
	24-hr Mean (as 90.4th%ile)	Discrete	504579, 5917491	14.7	15	22.7	50	45%

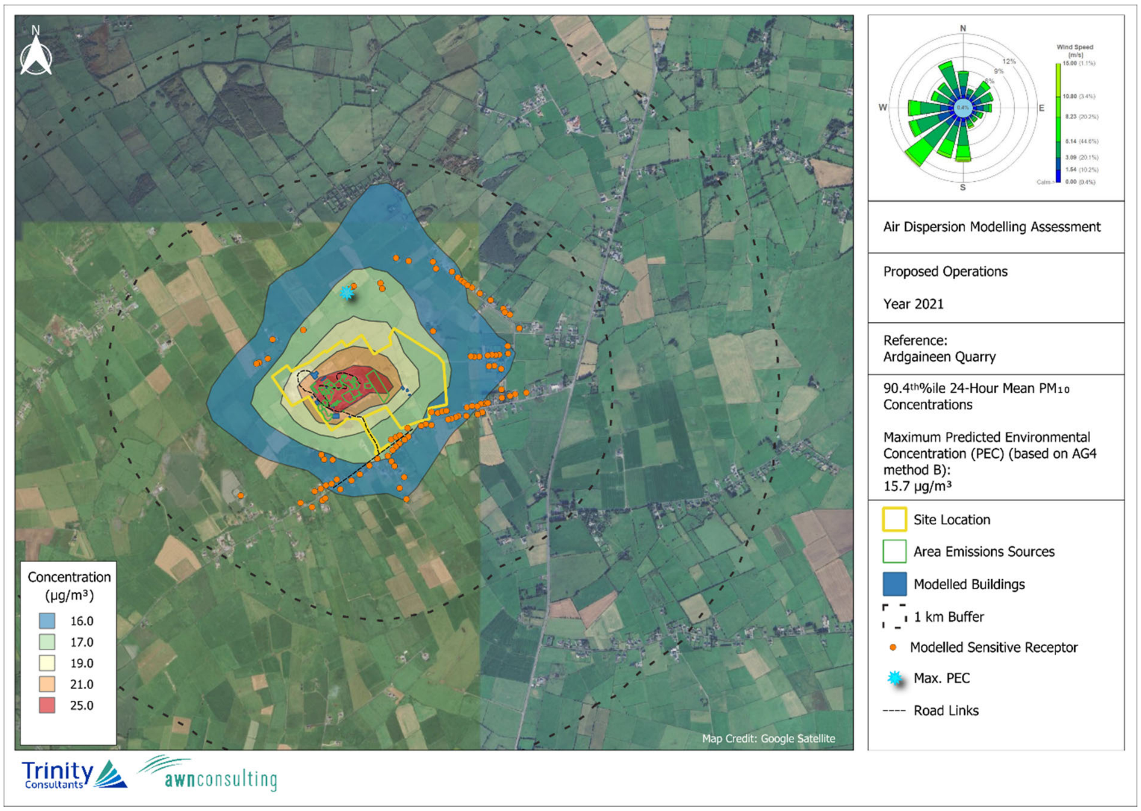

Figure 0.2 Maximum 24-Hr PM_{10} Concentration (as a 90.4th%ile) (µg/m^3) – Proposed Operations

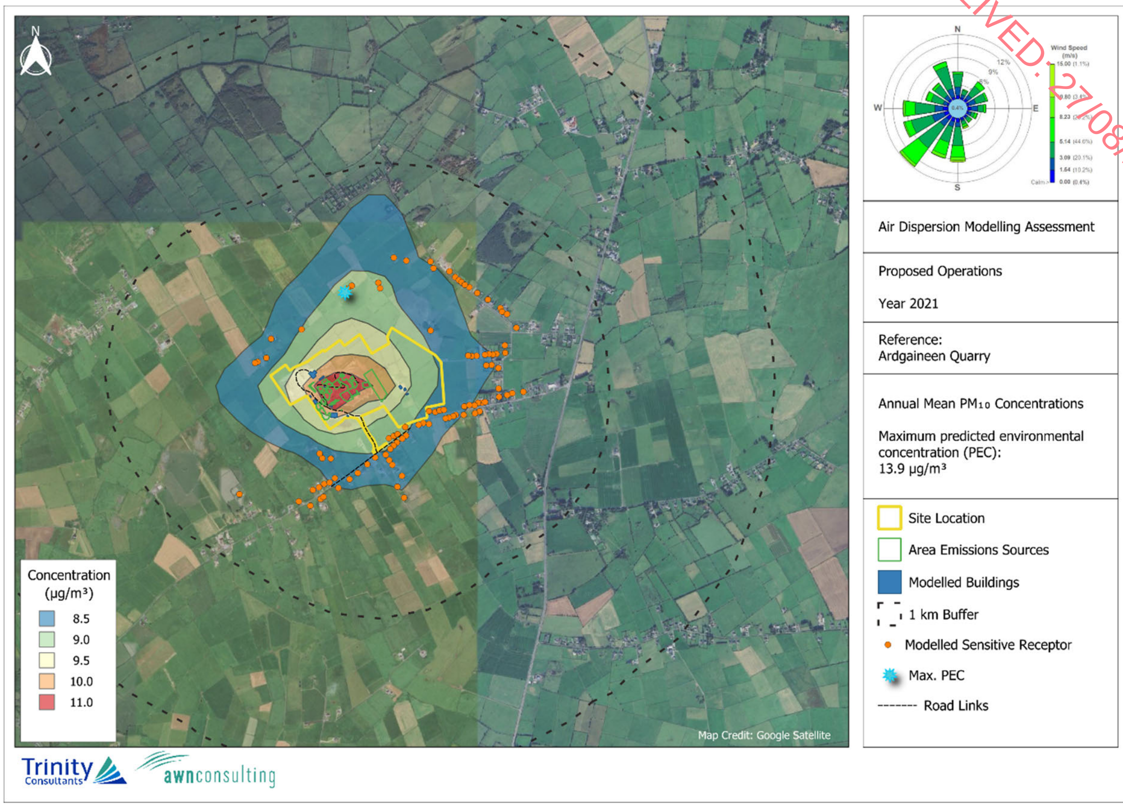

Figure 0.3 Annual Mean PM_{10} Concentration (µg/m^3) – Proposed Operations

$PM_{2.5}$

10.60 Predicted $PM_{2.5}$ concentrations at the worst-case receptor are significantly lower than the limit value of 25 µg/m^3 (Table 0.3) for the proposed development.

10.61 The predicted annual concentration (excluding background, i.e. process contribution (PC)) at the worst-case receptor peaks at 2.46 µg/m^3, which is 10% of the $PM_{2.5}$ annual mean limit value.

10.62 Based on a background $PM_{2.5}$ concentration of 6 µg/m^3 in the region of the site, the annual $PM_{2.5}$ concentration including the operations peaks at 8.46 µg/m^3 (i.e. predicted environmental concentration (PEC)). This peak level equates to 34% of the annual limit value for $PM_{2.5}$.

10.63 The impact of $PM_{2.5}$ is considered direct, slight, negative, localised and long-term.

Table 0.3 Proposed Operations – Dispersion Model Results for $PM_{2.5}$

Pollutant / Year	Averaging Period	Worst Case Receptor		Concentrations (µg/m^3)				PEC as % of Limit
		Type	X,Y (UTM Zone 29 N)	PC	Back-ground	PEC	Limit Value	
$PM_{2.5}$ / 2020	Annual Mean	Sensitive	504876, 5918519	2.02	6	8.02	25	32%
$PM_{2.5}$ / 2021	Annual Mean	Sensitive	504706, 5918534	2.42	6	8.42	25	34%
$PM_{2.5}$ / 2022	Annual Mean	Sensitive	504876, 5918519	2.44	6	8.44	25	34%
$PM_{2.5}$ / 2023	Annual Mean	Sensitive	504876, 5918519	1.97	6	7.97	25	32%
$PM_{2.5}$ / 2024	Annual Mean	Sensitive	504511, 5917522	2.46	6	8.46	25	34%

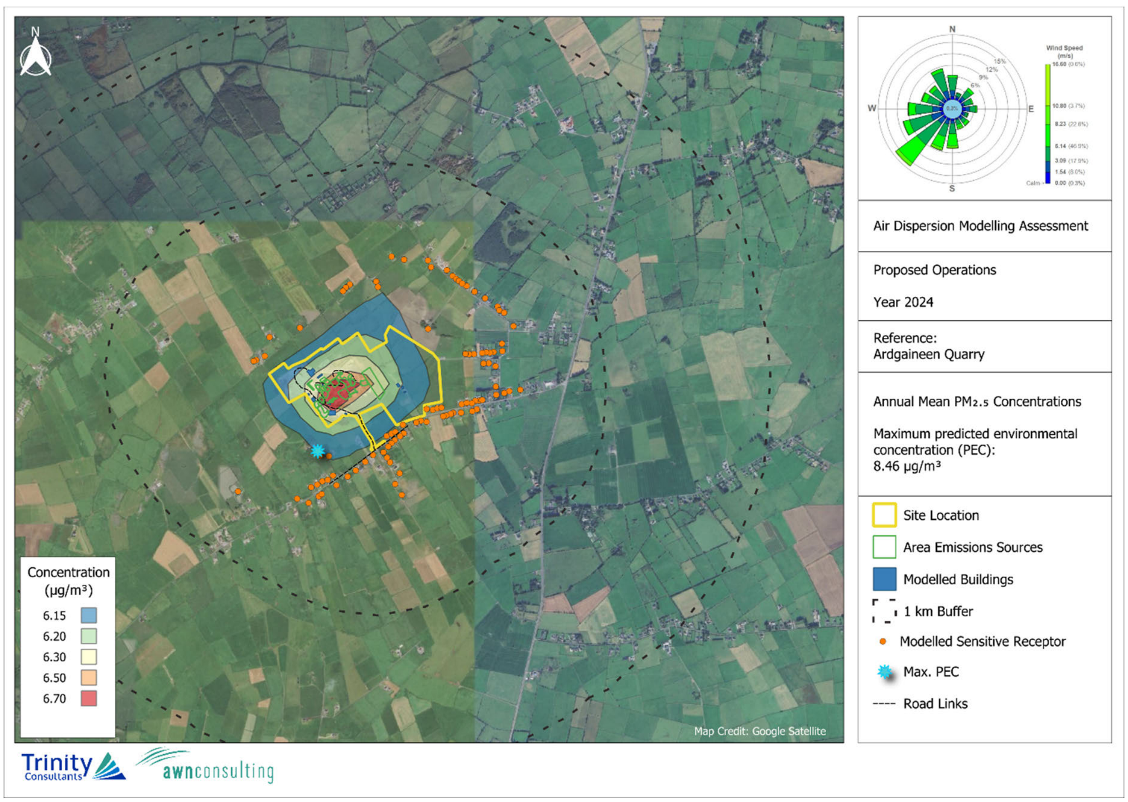

Figure 0.4 Annual Mean $PM_{2.5}$ Concentration (µg/m^3) – Proposed Operations

Road Traffic Emissions

10.64 There is the potential for a number of emissions to the atmosphere during the operational phase of the development. In particular, the traffic-related air emissions may generate quantities of air pollutants such as NO_2, PM_{10}, $PM_{2.5}$ and CO_2.

10.65 The traffic generated as part of the proposed development was reviewed against the TII screening criteria as outlined in Section 2.3. It was determined that none of the roads impacted by the development met the screening criteria. Therefore, impacts from road traffic emissions on local air quality are considered ***direct***, ***long-term, negative*** and ***imperceptible***.

Human Health

10.66 Air dispersion modelling of operational activities at the site was undertaken to assess the impact of the development with reference to EU ambient air quality standards which are based on the protection of human health. As demonstrated by the modelling results, emissions of PM_{10} and $PM_{2.5}$ are compliant with all National and EU ambient air quality limit values (Table 0.1). Therefore, the development will not result in a significant impact on human health.

Mitigation and Monitoring

Mitigation

10.67 There are a number of mitigation measures in place on site to prevent significant dust emissions from on-site activities. These measures include:

- A wheel wash is in place on site which trucks must pass through prior to exiting onto the public road.
- All fine materials are covered when leaving the site to prevent dust escaping.
- Dust suppression in the form of a sprinkler system is in place.
- Speeds restrictions are in place on site and to be imposed on the proposed private road.
- On-site roads are paved and dampened.
- A dust management plan has been prepared: refer to Appendix 5.

10.68 These measures have been incorporated into the modelling assessment to determine the impact of the site on levels of dust deposition and ambient levels of particulate matter (PM_{10}/$PM_{2.5}$). The modelling assessment found that there was a slight negative impact on the ambient air quality environment as a result of the development. These mitigation measures will continue to be enforced to prevent significant dust emissions from the site.

Monitoring

10.69 It is recommended that dust deposition monitoring continue to be undertaken at the boundary of the site. Monitoring will ensure that the TA Luft guideline limit value of 350 mg/m^2/day is complied with at the site boundary. Monitoring can be carried out using the Bergerhoff method as recommended by the Department of Environment, Heritage and Local Government (DEHLG, 2004). If monitoring indicates a potential issue with dust deposition, additional mitigation measures shall be implemented to remediate. Monitoring should be conducted at the western, eastern and northern site boundaries at a minimum as these areas are closest to sensitive receptors.

Residual Impacts

10.70 With the range of mitigation measures to be implemented and design measures to be incorporated into the working scheme, it is considered that the risk of dust impact at receptors from the proposed development reduces further. The proposed screening berms and the location of the stockpiles in the quarry floor act as significant mitigation measures against the dispersal of dust.

10.71 After an assessment of potential adverse effects produced by the development it was concluded that there would be no significant adverse air quality effects for both human and ecological receptors.

'Do-Nothing' Scenario

10.72 The site is currently operated as a quarry, with ongoing extraction and processing activities. The proposed development involves a lateral extension of the extraction area but does not include any changes to existing processing operations. In the Do-Nothing Scenario, no further extraction would occur beyond the existing permitted area, and operations would continue at current levels. Therefore, dust deposition, PM_{10} and $PM_{2.5}$ emissions, and traffic emissions are expected to remain consistent with existing baseline conditions.

10.73 The main potential sources of emissions to air will be associated with plant and machinery undertaking day to day activities such as extraction, onsite processing and transportation of material and dust blow generated during dry, windy conditions. Potential impacts associated with day-to-day activities have been separated into dust deposition and vehicle and plant emissions. The assessment is based on the proposed increased traffic volume of 170 truckloads per day.

Dust Deposition

10.74 Based on a background dust deposition of 150 mg/m^2/day in the region of the site, the combined background and process contribution dust deposition level peaks at 234.4 mg/m^2/day which is 67% of the TA Luft Limit Value of 350 mg/m^2/day. Figure 0.1 shows the geographical variation in annual dust deposition levels in the region of development.

10.75 The dust deposition level decreases with increasing distance from the site. The worst-case dust deposition at the closest sensitive receptor to the site peaks at 22.9 mg/m2/day or 6.5% of the TA Luft limit value, excluding background concentrations.

10.76 The impact of dust deposition is considered direct, slight, negative, localised and long-term.

Table 0.1 Do-Nothing – Dispersion Model Results for TSP

Pollutant / Year	Averaging Period	Worst Case Receptor		Concentrations (g/m²/day)				PEC as % of Limit
		Type	X,Y (UTM Zone 29 N)	PC	Back-ground	PEC	Limit Value	
Dust / 2020	Annual Mean	Boundary	504861, 5917547	74.4	150	224.4	350	64%
Dust / 2021	Annual Mean	Boundary	504861, 5917547	84.4	150	234.4	350	67%
Dust / 2022	Annual Mean	Boundary	504861, 5917547	80.2	150	230.2	350	66%
Dust / 2023	Annual Mean	Boundary	504861, 5917547	75.2	150	225.2	350	64%
Dust / 2024	Annual Mean	Boundary	504861, 5917547	79.8	150	229.8	350	66%

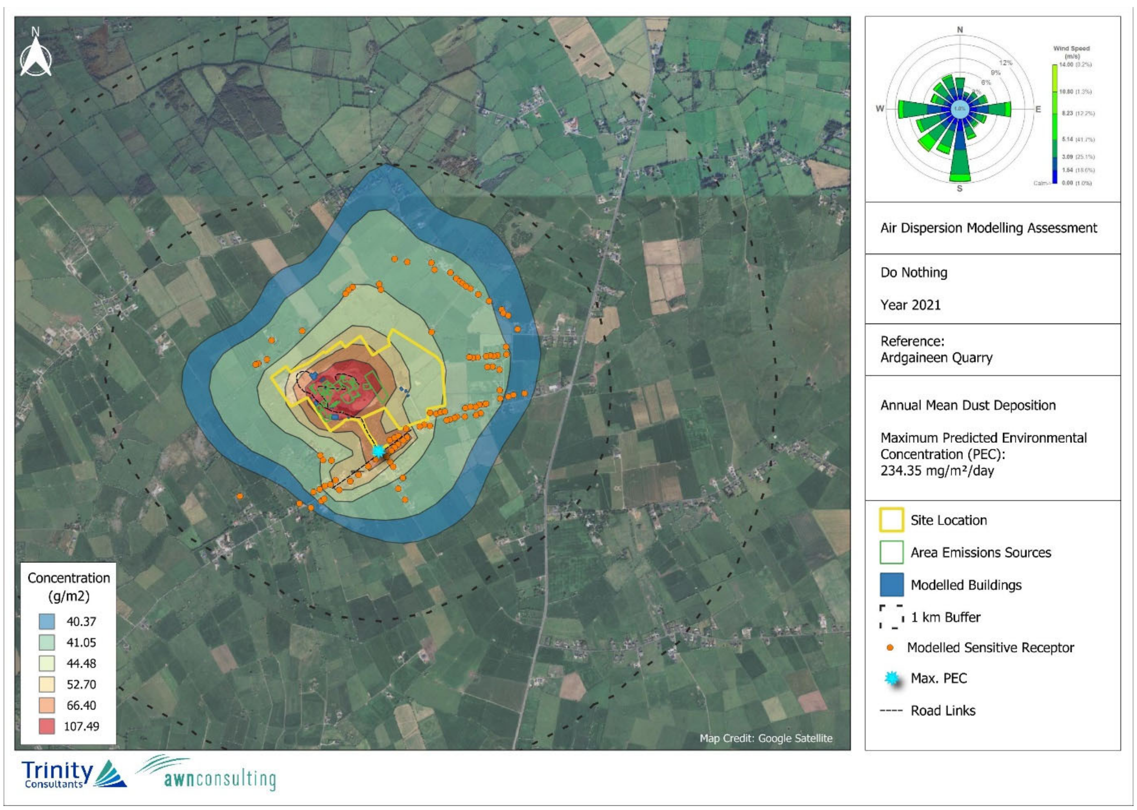

Figure 0.1 Annual Mean Dust Deposition Rate (g/m²/yr) – Do Nothing

PM_{10}

10.77 Predicted PM_{10} concentrations are significantly lower than the ambient air quality standards at the worst-case residential receptor due to background concentrations and emissions from the proposed development. For emissions from the proposed development the predicted 24-hour and annual mean concentrations (excluding background, i.e. process contribution (PC)) at the worst-case receptor peak at 15.0 µg/m^3 (29% of the PM_{10} annual mean limit value) and 5.6 µg/m^3 (13% of the PM_{10} annual mean limit value) respectively.

10.78 Based on an annual mean background PM10 concentration of 8 µg/m3 in the region of the proposed development, the combined annual PM10 concentration including the site, i.e. predicted environmental concentration (PEC), peaks at 13.6 µg/m3 (Table 0.2). This predicted level equates to at most 34% of the annual limit value of 40 µg/m3.

10.79 Based on a 24hr (90.4th%ile) mean concentration of 15 µg/m3, the predicted 24-hour PM10 concentration (including background) peaks at 23.0 µg/m3 which is 46% of the 24-hour limit value of 50 µg/m3 (measured as a 90.4th%ile).

10.80 The geographical variation in the 24-hour mean (90.4th%ile) PM10 ground level concentrations are illustrated as concentration contours in Figure 0.2. The geographical variation in annual PM10 ground level concentrations in the region of the development (Figure 0.3). The locations of the maximum concentrations for PM10 are close to the boundary of the site with concentrations decreasing with distance from the development.

10.81 The dust deposition level decreases with increasing distance from the site. The worst-case dust deposition at the closest sensitive receptor to the site peaks at 13.9 mg/m2/day or 17% of the TA Luft limit value, including background concentrations.

10.82 The impact of PM10 is considered direct, slight, negative, localised and long-term.

Table 0.2 Do-Nothing – Dispersion Model Results for PM_{10}

Pollutant / Year	Averaging Period	Worst Case Receptor		Concentrations (µg/m^3)				PEC as % of Limit
		Type	X,Y (UTM Zone 29 N)	PC	Back-ground	PEC	Limit Value	
PM_{10} / 2020	Annual Mean	Sensitive	504876, 5918519	4.4	8	12.4	40	31%
	24-hr Mean (as 90.4th%ile)	Discrete	504876, 5918519	12.7	15	20.7	50	41%
PM_{10} / 2021	Annual Mean	Sensitive	504664, 5918493	5.6	8	13.6	40	34%
	24-hr Mean (as 90.4th%ile)	Discrete	504706, 5918534	15.0	15	23.0	50	46%
PM_{10} / 2022	Annual Mean	Sensitive	504876, 5918519	5.3	8	13.3	40	33%
	24-hr Mean (as 90.4th%ile)	Discrete	504664, 5918494	13.7	15	21.7	50	43%
PM_{10} / 2023	Annual Mean	Sensitive	504876, 5918519	4.4	8	12.4	40	31%
	24-hr Mean (as 90.4th%ile)	Discrete	504511, 5917522	13.1	15	21.1	50	42%

Pollutant / Year	Averaging Period	Worst Case Receptor		Concentrations (µg/m³)				PEC as % of Limit
		Type	X,Y (UTM Zone 29 N)	PC	Background	PEC	Limit Value	
PM_{10} / 2024	Annual Mean	Sensitive	504511, 5917522	5.3	8	13.3	40	33%
	24-hr Mean (as 90.4th%ile)	Discrete	504579, 5917491	14.5	15	22.5	50	45%

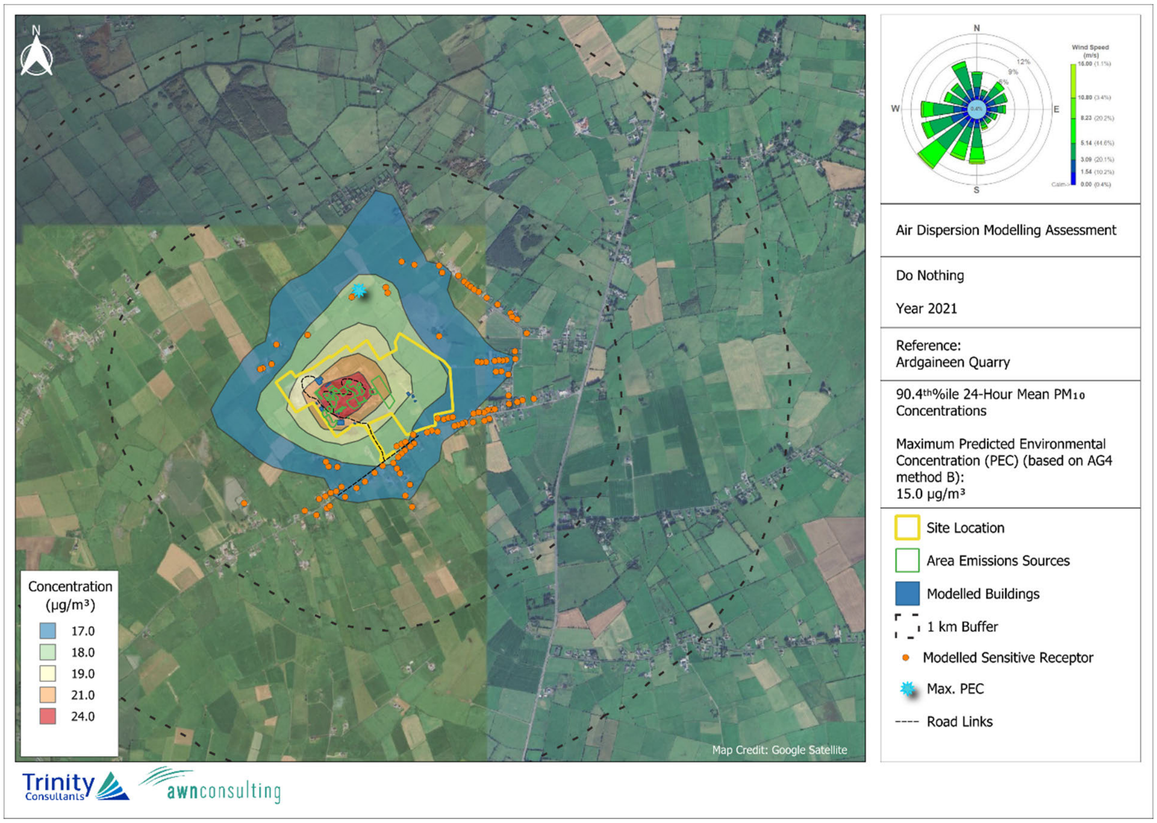

Figure 0.2 Maximum 24-Hr PM_{10} Concentration (as a 90.4th%ile) (µg/m³) – Do Nothing

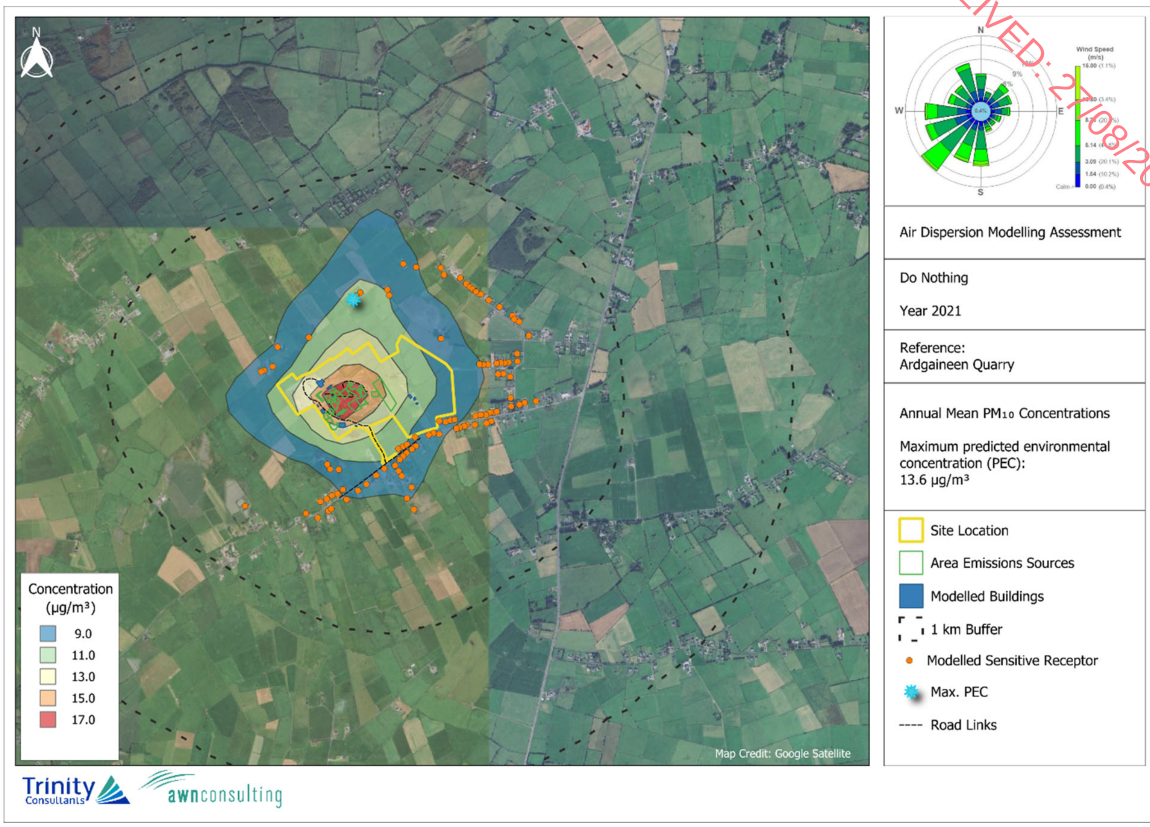

Figure 0.3 Annual Mean PM_{10} Concentration (µg/m^3) – Do Nothing

$PM_{2.5}$

10.83 Predicted $PM_{2.5}$ concentrations at the worst-case receptor are significantly lower than the limit value of 25 µg/m^3 (Table 0.3) for the proposed development.

10.84 The predicted annual concentration (excluding background, i.e. process contribution (PC)) at the worst-case receptor peaks at 2.42 µg/m3, which is 10% of the PM2.5 annual mean limit value.

10.85 Based on a background PM2.5 concentration of 6 µg/m3 in the region of the site, the annual PM2.5 concentration including the operations peaks at 8.42 µg/m3. This peak level equates to 34% of the annual limit value for PM2.5.

10.86 The impact of PM2.5 is considered direct, slight, negative, localised and long-term.

Table 0.3 Do-Nothing – Dispersion Model Results for $PM_{2.5}$

Pollutant / Year	Averaging Period	Worst Case Receptor		Concentrations (µg/m^3)				PEC as % of Limit
		Type	X,Y (UTM Zone 29 N)	PC	Back-ground	PEC	Limit Value	
$PM_{2.5}$ / 2020	Annual Mean	Sensitive	504876, 5918519	1.95	6	7.95	25	32%

Pollutant / Year	Averaging Period	Worst Case Receptor		Concentrations (µg/m³)				PEC as % of Limit
		Type	X,Y (UTM Zone 29 N)	PC	Back-ground	PEC	Limit Value	
$PM_{2.5}$ / 2021	Annual Mean	Sensitive	504706, 5918534	2.37	6	8.37	25	33%
$PM_{2.5}$ / 2022	Annual Mean	Sensitive	504876, 5918519	2.35	6	8.35	25	33%
$PM_{2.5}$ / 2023	Annual Mean	Sensitive	504876, 5918519	1.91	6	7.91	25	32%
$PM_{2.5}$ / 2024	Annual Mean	Sensitive	504511, 5917522	2.42	6	8.42	25	34%

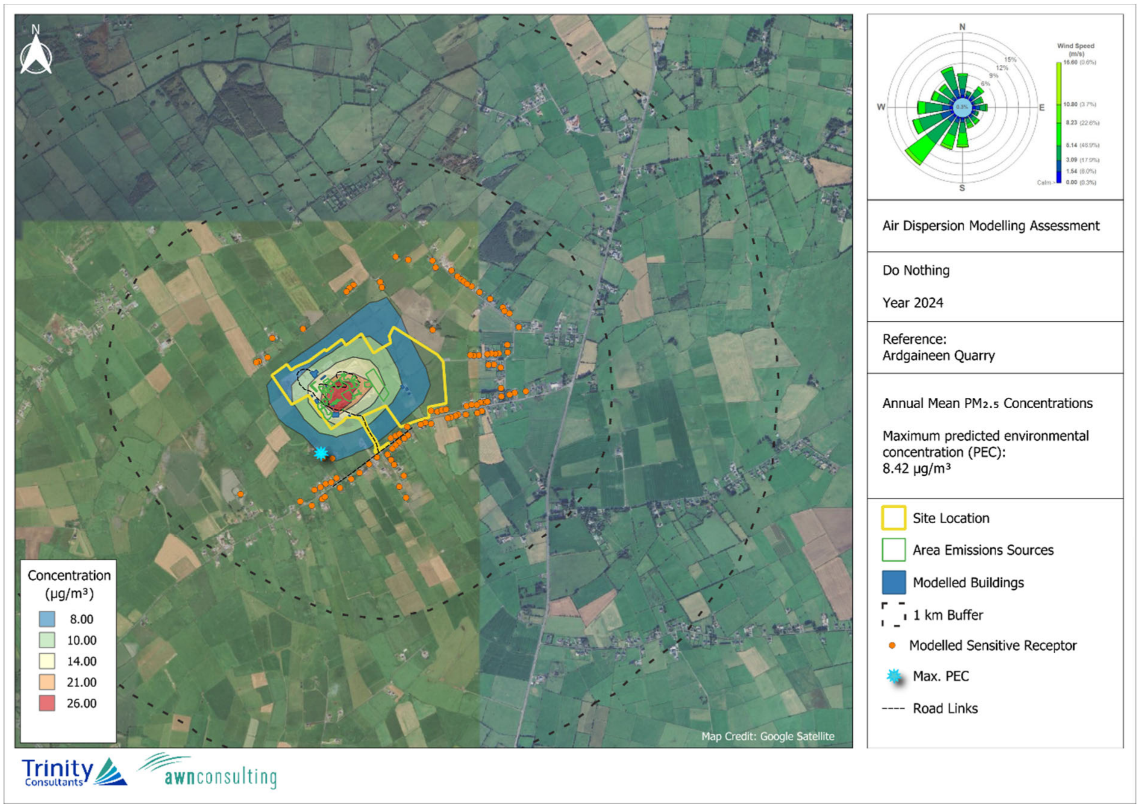

Figure 0.4 Annual Mean $PM_{2.5}$ Concentration (µg/m³) – Do Nothing

Cumulative Effects

10.87 Cumulative effects have been assessed for the proposed development. Background concentrations have been included in the modelling study for dust deposition and EPA data for PM_{10} and $PM_{2.5}$. These background concentrations account for non-localised sources of the pollutants of concern.

10.88 There are no other significant sources of dust, PM_{10} or $PM_{2.5}$ within the area of impact from the site. As a result, no further prediction of cumulative impact is required.

Residual Effects

10.89 It is not anticipated that there will be a significant adverse impact on air quality in the vicinity of the proposed development. Modelled emissions from the proposed development indicate ambient concentrations are well below the relevant ambient air quality standards for dust, PM_{10} and $PM_{2.5}$. Thus, the impact on air quality of the proposed development is not significant and no residual impact is anticipated.

Difficulties Encountered

10.90 There were no difficulties encountered when compiling this assessment.

References

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- Environmental Protection Agency (2015) *Advice Notes for Preparing Environmental Impact Statements (Draft) on the Information to be Contained in Environmental Impact Assessment Reports (Draft)*
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- USEPA (1986) *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition* (periodically updated)
- USEPA (2017) *Guidelines on Air Quality Models*, Appendix W to Part 51, 40 CFR Ch.1
- USEPA (2018) User's Guide to the AERMOD Meteorological Pre-processor (AERMET)
- USEPA (2021) AERMOD Description of Model Formulation and Evaluation

Appendices

Appendix 1: Description of Aermod Model

10.91 The AERMOD dispersion model has been developed in part by the U.S. Environmental Protection Agency[(1),(2)]. The model is a steady-state Gaussian model used to assess pollutant concentrations associated with industrial sources. The model is an enhancement on the Industrial Source Complex-Short Term 3 (ISCST3) model which has been widely used for emissions from industrial sources.

10.92 Improvements over the ISCST3 model include the treatment of the vertical distribution of concentration within the plume. ISCST3 assumes a Gaussian distribution in both the horizontal and vertical direction under all weather conditions. AERMOD with PRIME, however, treats the vertical distribution as non-Gaussian under convective (unstable) conditions while maintaining a Gaussian distribution in both the horizontal and vertical direction during stable conditions. This treatment reflects the fact that the plume is skewed upwards under convective conditions due to the greater intensity of turbulence above the plume than below. The result is a more accurate portrayal of actual conditions using the AERMOD model. AERMOD also enhances the turbulence of night-time urban boundary layers thus simulating the influence of the urban heat island.

10.93 In contrast to ISCST3, AERMOD is widely applicable in all types of terrain. Differentiation of the simple versus complex terrain is unnecessary with AERMOD. In complex terrain, AERMOD employs the dividing-streamline concept in a simplified simulation of the effects of plume-terrain interactions. In the dividing-streamline concept, flow below this height remains horizontal, and flow above this height tends to rise up and over terrain. Extensive validation studies have found that AERMOD (precursor to AERMOD with PRIME) performs better than ISCST3 for many applications and as well or better than CTDMPLUS for several complex terrain data sets[(3)].

10.94 Due to the proximity to surrounding buildings, the PRIME (Plume Rise Model Enhancements) building downwash algorithm has been incorporated into the model to determine the influence (wake effects) of these buildings on dispersion in each direction considered. The PRIME algorithm considers the position of the stack relative to the building in calculating building downwash. In the absence of the building, the plume from the stack will rise due to momentum and/or buoyancy forces. Wind streamlines act on the plume leads to the bending over of the plume as it disperses. However, due to the presence of the building, wind streamlines are disrupted leading to a lowering of the plume centreline.

10.95 When there are multiple buildings, the building tier leading to the largest cavity height is used to determine building downwash. The cavity height calculation is an empirical formula based on building height, the length scale (which is a factor of building height & width) and the cavity length (which is based on building width, length and height). As the direction of the wind will lead to the identification of differing dominant tiers, calculations are carried out in intervals of 10 degrees.

10.96 In PRIME, the nature of the wind streamline disruption as it passes over the dominant building tier is a function of the exact dimensions of the building and the angle at which the wind approaches the building. Once the streamline encounters the zone of influence of the building, two forces act on the plume. Firstly, the disruption caused by the building leads to increased turbulence and enhances horizontal and vertical dispersion. Secondly, the streamline descends in the lee of the building due to the reduced pressure and drags the plume (or part of) nearer to the ground, leading to higher ground level concentrations. The model calculates the descent of the plume as a function of the building shape and, using a numerical plume rise model, calculates the change in the plume centreline location with distance downwind.

10.97 The immediate zone in the lee of the building is termed the cavity or near wake and is characterised by high intensity turbulence and an area of uniform low pressure. Plume mass captured by the cavity region is re-emitted to the far wake as a ground-level volume source. The volume source is located at the base of the lee wall of the building but is only evaluated near the end of the near wake and beyond. In this region, the disruption caused by the building downwash gradually fades with distance to ambient values downwind of the building.

10.98 AERMOD has made substantial improvements in the area of plume growth rates in comparison to ISCST3[(1)(4)]. ISCST3 approximates turbulence using six Pasquill-Gifford-Turner Stability Classes and bases the resulting dispersion curves upon surface release experiments. This treatment, however, cannot explicitly account for turbulence in the formulation. AERMOD is based on the more realistic modern planetary boundary layer (PBL) theory which allows turbulence to vary with height. This use of turbulence-based plume growth with height leads to a substantial advancement over the ISCST3 treatment.

10.99 Improvements have also been made in relation to mixing height[(1)(4)]. The treatment of mixing height by ISCST3 is based on a single morning upper air sounding each day. AERMOD, however, calculates mixing height on an hourly basis based on the morning upper air sounding and the surface energy balance, accounting for the solar radiation, cloud cover, reflectivity of the ground and the latent heat due to evaporation from the ground cover. This more advanced formulation provides a more realistic sequence of the diurnal mixing height changes.

10.100 AERMOD also has the capability of modelling both unstable (convective) conditions and stable (inversion) conditions. The stability of the atmosphere is defined by the sign of the sensible heat flux. Where the sensible heat flux is positive, the atmosphere is unstable whereas when the sensible heat flux is negative the atmosphere is defined as stable. The sensible heat flux is dependent on the net radiation and the available surface moisture (Bowen Ratio). Under stable (inversion) conditions, AERMOD has specific algorithms to account for plume rise under stable conditions, mechanical mixing heights under stable conditions and vertical and lateral dispersion in the stable boundary layer.

10.101 AERMOD also contains improved algorithms for dealing with low wind speed (near calm) conditions. As a result, AERMOD can produce model estimates for conditions when the wind speed may be less than 1 m/s, but still greater than the instrument threshold.

(1) USEPA (1995) User's Guide for the Industrial Source Complex (ISC3) Dispersion Model Vol I & II

(2) USEPA (1998) Human Health Risk Assessment Protocol, Chapter 3: Air Dispersion and Deposition Modelling, Region 6 Centre for Combustion Science and Engineering

(3) Paine, R & Lew, F. "Results of the Independent Evaluation of ISCST3 and ISC-PRIME" Prepared for the EPRI, ENSR Document No. 2460-026-3527-02 (1997).

(4) USEPA (2000) Seventh Conference on Air Quality Modelling (June 2000) Vol I & II

Appendix 2: Aermet

AERMOD incorporates a meteorological pre-processor AERMET (version 24142)[2]. AERMET allows AERMOD to account for changes in the plume behaviour with height. AERMET calculates hourly boundary layer parameters for use by AERMOD, including friction velocity, Monin-Obukhov length, convective velocity scale, convective (CBL) and stable boundary layer (SBL) height and surface heat flux. AERMOD uses this information to calculate concentrations in a manner that accounts for changes in dispersion rate with height, allows for a non-Gaussian plume in convective conditions, and accounts for a dispersion rate that is a continuous function of meteorology.

The AERMET meteorological preprocessor requires the input of surface characteristics, including surface roughness (z0), Bowen Ratio and albedo by sector and season, as well as hourly observations of wind speed, wind direction, cloud cover, and temperature. A morning sounding from a representative upper air station, latitude, longitude, time zone, and wind speed threshold are also required.

Two files are produced by AERMET for input to the AERMOD dispersion model. The surface file contains observed and calculated surface variables, one record per hour. The profile file contains the observations made at each level of a meteorological tower, if available, or the one-level observations taken from other representative data, one record level per hour.

From the surface characteristics (i.e. surface roughness, albedo and amount of moisture available (Bowen Ratio)) AERMET calculates several boundary layer parameters that are important in the evolution of the boundary layer, which, in turn, influences the dispersion of pollutants. These parameters include the surface friction velocity, which is a measure of the vertical transport of horizontal momentum; the sensible heat flux, which is the vertical transport of heat to/from the surface; the Monin-Obukhov length which is a stability parameter relating the surface friction velocity to the sensible heat flux; the daytime mixed layer height; the nocturnal surface layer height and the convective velocity scale which combines the daytime mixed layer height and the sensible heat flux. These parameters all depend on the underlying surface.

The values of albedo, Bowen Ratio and surface roughness depend on land-use type (e.g., urban, cultivated land etc) and vary with seasons and wind direction. The assessment of appropriate land-use types was carried out in line with USEPA recommendations[6] and using the detailed methodology outlined by the Alaska Department of Environmental Conservation[7]. AERMET has also been updated to allow for an adjustment of the surface friction velocity (u*) for low wind speed stable conditions based on the work of Qian and Venkatram. Previously, the model tended to over-predict concentrations produced by near-ground sources in stable conditions.

Surface Roughness

Surface roughness length is the height above the ground at which the wind speed goes to zero. Surface roughness length is defined by the individual elements on the landscape such as trees and buildings. To determine surface roughness length, the USEPA recommends that a representative length be defined for each sector, based on geometric mean of the inverse distance area-weighted land use within the sector, by using the eight land use categories outlined by the USEPA. The area-weighted surface roughness length derived from the land use classification within a radius of 1km from Athenry meteorological station (Table 1).

Table 1. Surface Roughness based on an inverse distance area-weighted average of the land use within a 1km radius of Athenry meteorological station

Sector	Inverse Distance Weighted Land Use Classification	Spring	Summer	Autumn	Winter [a]
0-360	100% Grassland	0.050	0.100	0.010	0.010

Winter defined as periods when surfaces covered permanently by snow whereas autumn is defined as periods when freezing conditions are common, deciduous trees are leafless and no snow is present (Iqbal (1983)). Thus, for the current location autumn more accurately defines "winter" conditions at the proposed facility.

Albedo

Noon-time Albedo is the fraction of the incoming solar radiation that is reflected from the ground when the sun is directly overhead. Albedo is used in calculating the hourly net heat balance at the surface for calculating hourly values of Monin-Obuklov length. The area-weighted arithmetic mean albedo derived from the land use classification over a 10km x 10km area centred on Athenry meteorological station (Table 2).

Table 2.Albedo based on an area-weighted arithmetic mean of the land use over a 10km x 10km area centred on Athenry meteorological station

Simple Average Land Use Classification	Spring	Summer	Autumn	Winter [a]
50% Grassland, 40% Cultivated Land, 5% Urban, 5% Coniferous Forest	0.17	0.19	0.20	0.20

a. For the current location autumn more accurately defines "winter" conditions at the proposed facility.

Bowen Ratio

The Bowen ratio is a measure of the amount of moisture at the surface of the earth. The presence of moisture affects the heat balance resulting from evaporative cooling which, in turn, affects the Monin-Obukhov length which is used in the formulation of the boundary layer. The area-weighted geometric mean Bowen ratio derived from the land use classification over a 10km x 10km area centered on Athenry meteorological station (Table 3).

Table 3.Bowen Ratio based on an area-weighted geometric mean of the land use over a 10km x 10km area centred on Athenry meteorological station

Geometric Mean Land Use Classification	Spring	Summer	Autumn	Winter [a]
50% Grassland, 40% Cultivated Land, 5% Urban, 5% Coniferous Forest	0.38	0.73	0.93	0.93

a. For the current location autumn more accurately defines "winter" conditions at the proposed facility.

(5) USEPA (2004) User's Guide to the AERMOD Meteorological Preprocessor (AERMET)
(6) USEPA (2005) Guidelines on Air Quality Models, Appendix W to Part 51, 40 CFR Ch.1

(7) Alaska Department of Environmental Conservation (2008) ADEC Guidance re AERMET Geometric Means (http://dec.alaska.gov/air/ap/modeling.htm)

Appendix 3: Emission Factors

Emission Factors Used In Dust Emission Calculations (USEPA, 1986 & subsequent updates, California Air Resources Board (CARB), 2021)):

Crushing

E = ((T*K)/(H*3600*A))*((365-P)/365) $g/s/m^2$

Where:

T = Annual Tonnage of Material (400,000 T)

K = 2.7 (Total Dust), 1.2 (PM_{10}) , 0.22 ($PM_{2.5}$)

H = Annual Hours of Operation (3650 hours)

A = Area of Activity ($500m^2$)

P = 194 Wet Days

Screening

E = ((T*K)/(H*3600*A))*((365-P)/365) $g/s/m^2$

Where:

T = Annual Tonnage of Material (400,000 T)

K = 12.5 (Total Dust), 4.3 (PM_{10}) , 0.28 ($PM_{2.5}$)

H = Annual Hours of Operation (3650 hours)

A = Area of Activity ($500m^2$)

P = 194 Wet Days

Compacting

E = ((2.6*(TSC)^1.2)/(((TSM)^1.3)*3.6*A))*((365-P)/365) $g/s/m^2$

Where:

TSC = Topsoil Silt Content (6.9%)

TMC = Topsoil Moisture Content (7.9%)

A = Area of Topsoil Removal ($10,000m^2$)

P = 194 Wet Days

TSP results multiplied by 0.1885 for PM_{10} and by 0.0263 for $PM_{2.5}$

Topsoil Removal

E = ((T*K)/(H*3600*A))*((365-P)/365)$g/s/m^2$

Where:

K = 29 (Total Dust), 13.7 (PM_{10}) , 2.07 ($PM_{2.5}$)

T = Annual Tonnage of Material (400,000 T)

H = Annual Hours of Operation (3650 hours)

A = Area of Topsoil Removal (10,000m^2)

P = 194 Wet Days

Material Loading

E =(K*T/((H*3.6)*A))g/s/m^2

Where:

K = 7.38E-03 (Total Dust), 3.49E-03 (PM_{10}) , 5.28E-04 ($PM_{2.5}$)

T = Annual Tonnage of Material (400,000 T)

H = Annual Hours of Operation (3650 hours)

A = Area of Activity (5m^2)

Conveyor

E = ((T*K)/(H*3600*A))*((365-P)/365) g/s/m^2

Where:

K = 1.5 (Total Dust), 0.55 (PM_{10}) , 0.14 ($PM_{2.5}$)

T = Annual Tonnage of Material (400,000 T)

H = Annual Hours of Operation (3650 hours)

A = Area of Activity (1,450m^2)

P = 194 Wet Days

Blasting

E = =((((A^1.5)*K)*N)/((H*3600)*$A) g/s/m^2

Where:

T = Annual Tonnage of Material (400,000 T)

K = 0.22 (Total Dust), 0.144 (PM_{10}) , 0.0066 ($PM_{2.5}$)

H = Annual Hours of Operation (3650 hours)

A = Area of Blasting (3,000m^2)

N = Number of Blasts per Annum (24)

Stock Pile

E = ((K)/(365-P)/365)/(A*F*24*3600) g/s/m^2

Where:

K = Emission Factor = 3.07E+04 (Total Dust), 1.53E+04 (PM_{10}) , 6.13E+03 ($PM_{2.5}$)

P = 194 Wet Days

A = Area (SP1 = 855m^2, SP2 = 2,206m^2, SP3 = 707m^2, SP4 = 3,019m^2, SP5 = 661m^2, SP6 = 1,257m^2, SP7 = 2,827m^2, SP8 = 1,385m^2, SP9 = 71m^2)

F = Frequency of Disturbance (300 days)

Road Haulage (Paved)

$E = [k*(sL)^{0.91}*(W)^{1.02}](1-(P)/4N)$ g/veh km

Where:

sL = surface silt loading (0.6 g/m^2)

k = 24 (Total Dust), 4.6 (PM_{10}), 0.66 ($PM_{2.5}$)

W = mean vehicle weight (25 tonnes laden out/14 tonnes unladen in)

P = 194 wet days

N = 365 days

Road Haulage (Unpaved)

E =[281.9*k*(s/12)a*(W/3)^b*((365-P)/365) g/veh km

Where:

s = surface silt content (10%)

k = 4.9 (Total Dust), 1.8 (PM_{10}), 0.15 ($PM_{2.5}$)

W = mean vehicle weight (25 tonnes laden out/14 tonnes unladen in)

a = 0.9 (PM_{10}/$PM_{2.5}$), 0.7 (Total Dust)

b = 0.45

P = 194 wet days

Wind Erosion of Stockpiles

The formulae for calculating wind erosion can be found in section 13.2.5 of AP42 titled *Industrial Wind Erosion*. Information on monthly peak wind speeds and the number of gales per month is required to calculate the emission rates.

Table 0.1 Proposed Operations Emission Factors

Operation	Total Dust Emission Rate (g/s/m^2)	PM_{10} Emission Rate (g/s/m^2)	$PM_{2.5}$ Emission Rate (g/s/m^2)
Crushing 1	3.57E-04	1.23E-04	7.99E-06
Crushing 2	1.11E-04	3.84E-05	2.50E-06
Screening 1	7.71E-05	3.42E-05	6.28E-06
Screening 2	2.41E-05	1.07E-05	1.96E-06
Bulldozing 1	2.34E-05	4.41E-06	6.16E-07
Bulldozing 2	7.80E-05	1.47E-05	2.05E-06
Topsoil Removal	4.14E-05	1.95E-05	2.95E-06

Material Loading	4.49E-02	2.12E-02	3.22E-03
Conveyor 1	5.35E-05	1.96E-05	4.99E-06
Conveyor 2	7.13E-05	2.62E-05	6.66E-06
Blasting	2.20E-05	1.14E-05	6.60E-07
Drilling	4.28E-07	1.90E-07	3.52E-08
Stock Pile 1	4.57E-05	2.29E-05	9.14E-06
Stock Pile 2	1.77E-05	8.86E-06	3.54E-06
Stock Pile 3	5.53E-05	2.77E-05	1.11E-05
Stock Pile 4	1.30E-05	6.48E-06	2.59E-06
Stock Pile 5	5.92E-05	2.96E-05	1.18E-05
Stock Pile 6	6.64E-05	3.32E-05	1.33E-05
Stock Pile 7	2.95E-05	1.48E-05	5.90E-06
Stock Pile 8	6.02E-05	3.01E-05	1.20E-05
Storage 1	1.77E-04	5.88E-05	2.35E-05
Storage 2	2.36E-05	7.86E-06	3.14E-06
Post WW Laden Out Paved	1.52E-03	5.05E-05	7.25E-06
Post WW Unladen In Paved	8.41E-04	2.80E-05	4.01E-06
Post WW Laden Out Road	2.03E-03	6.75E-05	9.69E-06
Post WW Unladen In Road	1.12E-03	3.74E-05	5.36E-06
Post WW Laden Out Site	2.08E-04	7.38E-05	6.15E-06
Post WW Unladen In Site	1.61E-04	5.69E-05	4.74E-06

Table 0.2 Do Nothing Emission Factors

Operation	Total Dust Emission Rate (g/s/m^2)	PM_{10} Emission Rate (g/s/m^2)	$PM_{2.5}$ Emission Rate (g/s/m^2)
Crushing 1	3.57E-04	1.23E-04	7.99E-06
Crushing 2	1.11E-04	3.84E-05	2.50E-06

Screening 1	7.71E-05	3.42E-05	6.28E-06
Screening 2	2.41E-05	1.07E-05	1.96E-06
Bulldozing 2	7.80E-05	1.47E-05	2.05E-06
Topsoil Removal	4.14E-05	1.95E-05	2.95E-06
Material Loading	4.49E-02	2.12E-02	3.22E-03
Conveyor 1	5.35E-05	1.96E-05	4.99E-06
Conveyor 2	7.13E-05	2.62E-05	6.66E-06
Blasting	2.20E-05	1.14E-05	6.60E-07
Drilling	4.28E-07	1.90E-07	3.52E-08
Stock Pile 1	4.57E-05	2.29E-05	9.14E-06
Stock Pile 2	1.77E-05	8.86E-06	3.54E-06
Stock Pile 3	5.53E-05	2.77E-05	1.11E-05
Stock Pile 4	1.30E-05	6.48E-06	2.59E-06
Stock Pile 5	5.92E-05	2.96E-05	1.18E-05
Stock Pile 6	6.64E-05	3.32E-05	1.33E-05
Stock Pile 7	2.95E-05	1.48E-05	5.90E-06
Stock Pile 8	6.02E-05	3.01E-05	1.20E-05
Storage 1	1.77E-04	5.88E-05	2.35E-05
Storage 2	2.36E-05	7.86E-06	3.14E-06
Post WW Laden Out Paved	1.52E-03	5.05E-05	7.25E-06
Post WW Unladen In Paved	8.41E-04	2.80E-05	4.01E-06
Post WW Laden Out Road	2.03E-03	6.75E-05	9.69E-06
Post WW Unladen In Road	1.12E-03	3.74E-05	5.36E-06
Post WW Laden Out Site	2.08E-04	7.38E-05	6.15E-06
Post WW Unladen In Site	1.61E-04	5.69E-05	4.74E-06

Appendix 4: Site Specific Air Quality Data

Table 0.3 Site Specific Air Quality Data (Daily Mean)

DATETIME	PM1	PM2.5	PM4	PM10	TSP
24/06/2025	0.71	2.49	5.07	9.71	11.92
25/06/2025	0.52	1.82	3.68	7.22	9.13
26/06/2025	1.52	5.68	11.96	22.49	26.97
27/06/2025	1.45	2.6	3.88	6.17	7.46
28/06/2025	1.72	3.67	5.53	8.25	9.8
29/06/2025	0.94	2.39	4.02	6.19	7.18
30/06/2025	0.38	1.2	2.72	5.97	7.88
01/07/2025	0.46	1.49	3.12	6	7.9
02/07/2025	0.44	1.77	4.2	9.45	12.68
03/07/2025	1.51	4.06	7.18	12.64	15.1
04/07/2025	1.86	3.99	6.3	10.08	11.79
05/07/2025	0.57	1.23	2.04	3.24	3.77
06/07/2025	0.44	1.14	1.97	3.11	3.85
07/07/2025	0.54	1.39	2.51	4.46	6.04
Averages	0.93	2.49	4.58	8.21	10.11

Appendix 5: Site Specific Dust Management Plan

DUST MANAGEMENT PLAN

PROPOSED LATERAL EXTENSION TO A LIMESTONE QUARRY AT ARDGAINEEN, CLAREGALWAY, CO. GALWAY

CLIENT NAME: HARRINGTONS CONCRETE AND QUARRIES
REFERENCE: 03.24

AUGUST 2025

Contents

Introduction

This dust management plan (DMP) is for the Proposed Lateral Extension to a Limestone Quarry at Ardgaineen, Claregalway, Co. Galway. This DMP should be read in conjunction with the main text of the Air Quality Assessment which assesses the potential dust and PM10 impacts on sensitive offsite receptors, in accordance with the IAQM Guidance on the assessment of mineral dust from quarries.

The guidance documents that have been consulted for the preparation of this DMP are:

- Mineral Industry Research Organisation (MIRO), Good practice guide: control and measurement of nuisance dust and PM_{10} from the extractive industries (2011);
- Institute of Air Quality Management (IAQM), Guidance on the Assessment of Mineral Dust Impacts for Planning (2016); and
- The supporting Air Quality Assessment for the Planning Application.

Overview of Dust Management Plan

The components of the DMP are set out within this document as follows:

- Identification of dust sources and influencing factors
- Control Measures
- Monitoring
- Management & Reporting

Dust Sources

Potential Dust Sources

- Drilling and Blasting
- Material handling – excavators
- Crushing and screening plant
- Material storage and stockpiles
- On-site transportation
- Off-site transportation

Management

Site Management

The quarry manager will exercise, either personally or by delegation to suitably trained and responsible staff, day-to-day control of the site. They will be responsible for the satisfactory working of the whole site and for ensuring full compliance with the DMP.

Quarry Staff

Staff at all levels will receive the necessary training and instruction in their duties relating to all operations and the potential sources of dust emissions. Particular emphasis will be given to plant and equipment malfunctions and abnormal conditions.

Any member of staff who fails to comply with the provisions of the DMP will be retrained as necessary and may also be subject to disciplinary action.

Contractors and Visitors

The quarry manager will ensure that contractors and visitors are aware of the need to comply with the provisions of this plan so far as they are relevant to their activities on site.

Dust Mitigation Measures

The existing and proposed dust mitigation measures that will be in operation throughout the proposed development are outlined in table 1 below.

Table 1: Existing and Proposed Dust Mitigation Measures

Activity	Mitigation Measure
Drilling and blasting	Drill rig is complete with a dust bagging unit.
Material handling	Minimise drop heights when handling materials. Avoid working in adverse/ windy conditions.
Crushing and screening plant	Locate plant within quarry void, where possible. Retention of hedgerows Existing and Proposed perimeter berms Avoid working in adverse weather conditions
Material storage and stockpiles	Located within quarry void Consideration required to be given to wind conditions prior to working on stockpiles Limit mechanical disturbance.
On-site transportation	Minimise distances of onsite haul routes. Use of water sprays / tractor & bowser to moisten surfaces during dry weather. Restrict vehicle speeds through signage / staff training. Location of haul routes away from sensitive receptors.
Off-site transportation	Use of road sweeper to reduce the amount of available material for re-suspension. Existing truck wash with overhead spray bars. Existing paved access road. All fine materials are covered when leaving the site to prevent dust escaping.
Asphalt Plant	Dryer with high-efficiency filter baghouse; CEMS on exhaust stack. Enclosed mixing tower and

	enclosed material transfers; double-door discharge. Aggregate hoppers in a three-sided covered shed with cold-feed; inclined conveyor to dryer. Bunded bitumen tanks; sealed pipework and secure tanker connection. Silos fitted with dust filters and top-level indicators; enclosed screw conveyor returns reclaimed dust to a storage silo. Trucks covered before departure; high-pressure wheel wash; fixed high-pressure sprinklers on access roads.

Monitoring

Meteorological Conditions

Weather forecasts will be monitored on a regular basis to predict weather conditions, such as prolonged dry, hot or significantly strong winds which may generate elevated levels of dust. Using this information, the necessary precautionary measures are employed on site, or certain activities are suspended if necessary.

Visual Dust Monitoring

Dust monitoring will be undertaken visual by site personnel throughout the working day, i.e. routine vigilance. In addition, the site manager provides observations and anything noteworthy is recorded in a logbook.

Dust Monitoring

Dust monitoring will continue at the site in compliance with condition 3 outlined in Galway County Council Plan File Ref. No. QY/55.

Emergency Response Measures

An emergency response procedure is to be followed in the event of major dust emissions.

For the purposes of the emergency response, major dust emissions will be defined as:

- Visible dust crossing the site boundary
- Persistent fugitive dust from mobile plant or haul movements
- Persistent wind-blown dust

Should control measures fail in preventing significant dust emissions, as above, then the following responses will be initiated:

- Relevant plant shall stop work immediately
- A fitter to be called to inspect any malfunctioning plant, if necessary

Complaints Procedure

All complaints will be recorded and reported to the quarry manager, who will investigate the circumstances and ensure that the necessary corrective measures are taken.

A prompt response will be made to the complainant and a record, including copies of all correspondence, will be held in a secure place at the quarry office.