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INTRODUCTION

8.1 This chapter of the Environment Impact Statement (EIS) deals with the issue of air quality. It primarily addresses potential dust related impacts from the proposed development and operation of an inert waste recovery facility to restore the quarry void at Calary Quarry, Killough Upper, Kilmacanogue, Co. Wicklow by backfilling it using imported soil and stone and re-establishing a heathland / grassland habitat similar to that which existed prior to quarrying.

8.2 SLR Consulting Ireland has been appointed to undertake dust deposition monitoring at the application site / former quarry and to prepare an air quality impact assessment report to be included as part of the Environmental Impact Statement (EIS) to accompany the planning application by Roadstone Limited for the proposed waste recovery facility at Calary Quarry.

Scope of Work

8.3 The main focus of the assessment is the potential impact on local amenity from fugitive dust emissions from the following activities :

- importation of inert soil waste from external sources (construction sites);
- stockpiling, placement and compaction of inert and site-won soil;
- placement of minor quantities of imported aggregate to construct temporary haul roads;
- stockpiling of topsoil pending final surface restoration works.

8.4 The principal air quality impact associated with the proposed recovery of inert soils through deposition is fugitive dust emission. Dust emissions are likely to arise during:

- trafficking by heavy goods vehicles (HGVs) over unpaved surfaces;
- end-tipping of inert soil;
- stockpiling, handling and compaction of inert soil;
- placement of small quantities of aggregate for road construction.

8.5 With respect to the potential for air quality impacts, the key objective at the application site is to manage activities in order to ensure that air emissions are prevented where possible and the effects of any residual releases are minimised.

8.6 This chapter describes and assesses the existing air quality baseline characteristics of the local area. Air emissions arising from the proposed waste recovery facility are then applied to these baseline conditions and the resulting air quality impacts assessed. Mitigation measures are identified where required, to eliminate and reduce these impacts insofar as practical.

8.7 The following sections of this Chpater describe the potential air quality impacts associated with activities within the proposed development. The following issues are addressed separately:

- relevant legislation, standards and guidance;
- methodology used to assess the potential impacts of the activities at the proposed recovery facility on air quality at local properties;
- baseline conditions pertaining to the measured (or estimated) existing air quality levels around the proposed facility;
- assessment of the impacts;

- description of mitigation measures that are incorporated into the construction, design and operation of the recovery facility to eliminate or reduce the potential for air quality impacts (if required);
- summary of any residual impacts and reinstatement;
- summary of cumulative impacts;
- monitoring proposals.

LEGISLATIVE FRAMEWORK / PLANNING POLICY

8.8 The following sections describe the main legislative policy requirements in respect of air quality associated with the proposed development.

Air Quality Strategy

8.9 The Government's policy on air quality within Ireland is set out in the Air Quality Standards (AQS) Regulations 2011. The CAFE Directive was transposed into Irish legislation by the Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011). It replaces the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002), the Ozone in Ambient Air Regulations 2004 (S.I. No. 53 of 2004) and the EPA Act 1992 (Ambient Air Quality Assessment and Management) Regulations 1999 (S.I. No. 33 of 1999). The 4th Daughter Directive was transposed by the Arsenic, Cadmium, Mercury, Nickel and Polycyclic Aromatic Hydrocarbons in Ambient Air Regulations 2009 (S.I.no. 58 of 2009).

8.10 The AQS sets out a framework for reducing hazards to health from air pollution and ensuring that international commitments are met in Ireland.

8.11 The AQS sets standards and objectives for ten priority pollutants. Standards are the concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. Objectives are policy targets, often expressed as maximum concentrations, not to be exceeded either without exception or with a limited number of exceedances within a specified timescale.

8.12 Under the AQS following pollutants are monitored: nitrogen oxides; sulphur dioxide; carbon monoxide; ozone; particulate matter (PM_{10}, $PM_{2.5}$ and black smoke), benzene and volatile organic compounds, heavy metals and polycyclic aromatic hydrocarbons. These pollutants are monitored at 29 stations across the country and together they form the national ambient air quality network.

8.13 The network is coordinated and managed by the EPA, as the National Reference Laboratory for Air Quality. The results of the monitoring are compared to limit values set out in EU and Irish legislation on ambient air quality. As recommended in the 2011 Review of the Environmental Protection Agency, map-based assessments are prepared and presented by the EPA.

8.14 In 2002, a Voluntary Agreement was established between the Minister for the Environment, Community and Local Government and the Solid Fuel Trade Group (SFTG), representing the majority of coal importers. The SFTG agreed that bituminous coal imported by its members would have a sulphur content of ≤0.7%.

National Planning Policy

8.15 The National Spatial Strategy (NSS) 2002-2020 (published on 28th November 2002) is a 20-year coherent national planning framework for Ireland. It aims to achieve a better balance of social, economic, and physical development across Ireland, supported by more effective and integrated planning. The strategy emphasises continued strong growth in the Greater Dublin Area (GDA), but with

significant improvement in other regions to achieve more balanced regional development. The NSS provides the policy framework for all regional and local plans.

8.16 At present, there are no specific policies relating to air emissions in National Planning Policy for extractive related industry. It is left to local authorities to consider the land use and planning issues associated with extractive industry and related activities in preparing their County Development Plans. The general objective in planning is to ensure that quarry products and outputs are managed in a sustainable way, so as to achieve a balance between environmental, economic and social considerations.

Local Planning Policy – Wicklow County Development Plan

8.17 The Wicklow County Development Plan which was adopted in 2010, includes a number policies and objectives for the planning and sustainable development of the County from 2010 to 2016. The Council's policies in respect of emissions to air (AE1 to AE3) are :

- *AE1 - to regulate and control activities likely to give rise to emissions to air (other than those activities which are regulated by the EPA);*
- *AE2 - to require proposals for new developments with the potential for the accidental release of chemicals or dust generation, to submit and have approved by the Local Authority construction and/or operation management plans to control such emissions;*
- *AE3 - to require activities likely to give rise to air emissions to implement measures to control such emissions, to install air quality monitors and to provide an annual air quality audit.*

These are restated as objectives WE9 to WE11 in Section 9.3 of the Draft Wicklow County Development Plan 2016 to 2022, published in November 2015.

Relevant Guidelines

8.18 Section 261 of the Planning and Development Act 2000 (as amended), which regulates quarry development, came into effect in April 2004. The Department of Environment guidance document *Quarries and Ancillary Activities – Guidelines for Planning Authorities (DoEHLG 2004)* was published around the same time

8.19 In 1996, the Irish Concrete Federation, the trade body representing the interests of quarry operators and producers of construction materials, published the *ICF Environmental Code* (updated in 2005) for its members, providing guidance on best practice in the environmental management of quarries

8.20 In 2006 the EPA published *Environmental Management Guidelines for Environmental Management in the Extractive Industry*

Construction and Dust Demolition Guidance

8.21 Guidance on the assessment of the impacts of construction and demolition activities on air quality and the determination of their significance has been prepared by the Institute of Air Quality Management (IAQM). This evaluates the risk of site activities and determines the significance of impacts once mitigation measures have been employed. The IAQM has also produced Dust and Mitigation Measure Guidance, complementing its significance guidance by describing measures in accordance with assessed risk.

8.22 Further guidance for control of dust from construction and demolition has been produced by the Building Research Establishment (BRE) and the Greater London Authority (GLA). The GLA guidance document presents site evaluation guidelines based upon the size (in m^2) or number of properties in the proposed development to rate the site between 'low risk' and 'high risk'. Based on the evaluation of risk, the guidance prescribes a range of best practice mitigation measures to be applied at development sites.

Dust Deposition Monitoring Practice and Emission Limit Values

Dust Deposition Limits

8.23 Fractions of dust greater than 10 µm (microgram) in diameter are not covered within the Air Quality Strategy and typically relate to nuisance effects as opposed to potential health effects. When the rate of accumulation of this coarser fraction of dust (referred to as deposited dust) is sufficiently rapid to cause fouling or discolouration then it is generally considered to introduce a nuisance. The point at which an individual perceives dust deposition as a nuisance and causes a complaint is highly subjective.

8.24 A range of monitoring techniques exist for dust deposition rates (i.e. Bergerhoff and Frisbee gauges). There are currently no UK, European Union (EU) or World Health Organisation (WHO) statutory standards or limits appropriate for the assessment of deposited dust and its propensity to generate annoyance.

8.25 Custom and practice criteria levels for the gravimetric assessment of dust deposition which are generally used across the extractive industry in Ireland include the DoEHLG (2004), ICF (2005) and EPA (2006) Environmental Management Guidelines[1]. The Guidelines recommend the use of the Bergerhoff method for measuring dust deposition. In line with this approach, the guidelines recommend the TA Luft dust deposition limit value of 350 mg/m^2/day (total dust deposition when averaged over a 30 day period), measured at the site boundaries

8.26 The nature of the dust deposit can also influence the perception of nuisance, for example black coal dust may have a high contrast with its background.

8.27 Surface soiling measures the effective area cover (EAC) as an indication of dust nuisance, assessing soiling rates as opposed to gravimetric methods which measure the mass of deposited dust. Research indicates that a soiling rate of 0.2% EAC/day is noticeable, whilst 0.5% EAC/day is judged to be the maximum generally acceptable. The colour and type of dust may influence what is considered tolerable however.

8.28 Condition No.13 imposed by Wicklow County Council (WCC) on the operation of Calary Quarry under the most recent planning permission (Ref. No. 06/6189), states that:

> *"Dust emissions from the site shall not exceed 350 milligrams/square metre per day averaged over a continuous period of 30 days, measured as deposition of insoluble particulate matter, at any position along the site boundary. Suitable arrangements shall be made to suppress and control dust arising from the open working, processing, handling, and transportation of*

[1] Environmental Protection Agency 2006. Environmental Management Guidelines; Environmental Management in the Extractive Industry (Non-Schedules Minerals).

mineral and / or product. The deposition of dust on surrounding lands in excess of allowed limits, or spillage onto public roads shall be prevented at all times".

8.29 The action of wind over dry ground will carry small particles into the air. Although large emissions of dust occur naturally, man-made dust events are caused by a range of activities including agriculture, road traffic, and construction works, handling, and storage of soils etc. and by vehicles using paved and unpaved site haul roads. For operations involving the mechanical break up of solids, the most common concern regarding dust emissions is the potential nuisance effect from the larger fractions of dust.

8.30 Potential impacts from larger fractions of dust typically relate to nuisance effects as opposed to potential health effects. When the rate of accumulation of this coarser fraction of dust (referred to as deposited dust) is sufficiently rapid to cause fouling or discolouration then it is generally considered to introduce a nuisance. The point at which an individual perceives dust deposition as a nuisance and causes a complaint is highly subjective; there are no statutory numerical limits that define at what level dust becomes a nuisance.

Dust and Ecological Receptors

8.31 A majority of the research on the effects of particulate matter on vegetation has focussed on the chemical effects of alkaline dusts. A summary of a review of available research on behalf of the UK's Department for the Environment Transport and Regions (DETR) concluded that:

"the issue of dust on ecological receptors is largely confined to the associated chemical effect of dust, and particularly the effect of acidic or alkaline dust influencing vegetation through soils."

8.32 An Interim Advice Note (IAN) prepared as a supplement for Volume 11, Section 3, part 1 of the UK DMRB (Design Manual for Roads and Bridges) and now incorporated into HA207/07) suggests that only dust deposition levels above 1,000mg/m^2/day are likely to affect sensitive ecological receptors. This level of dust deposition is approximately five times greater than the level at which most dust deposition may start to cause a perceptible nuisance to humans. It states that most species appear to be unaffected until dust deposition rates are at levels considerably higher than this.

RECEIVING ENVIRONMENT

Baseline Study Methodology

Local Review and Assessment of Air Quality & Monitoring

8.33 The application site and surrounding area fall into Air Quality Zone D, categorised as rural locations throughout Ireland. No monitoring in the vicinity of the site is routinely undertaken for air pollutants regulated under the Air Quality Standards Regulations (S.I. No. 180 of 2011).

8.34 The closest air quality monitoring location to the proposed recovery facility, and in a similar Zone D area, is located at a suburban location in Bray, approximately 5km north-east of the application site. As such, it is considered the most appropriate dataset available for assessment baseline concentrations in the study area. The Bray site monitoring station is located in the grounds of (former) Bray Town Council Yard on Wurzburg Road.

8.35 The Bray monitoring station continuously monitors concentrations of particulate matter with an aerodynamic diameter of less than 10µm (PM_{10}). Recent annual mean concentrations monitored at Bray (published on the EPA website[2]) are presented in Table 8-1 below.

Table 8- 1
Background PM_{10} Background Concentrations - Bray

Year	Annual Mean (µg/m^3)	Number of Days >50µg/m^3
2010	12.7	0
2014	17.0	1

8.36 Table 8-1 illustrates that PM_{10} concentrations monitored at the Bray monitoring site are below the annual mean Air Quality Standards (AQS) of 40µg/m^3 and comply with the requirement that a 24-hour mean of 50µg/m^3 should not be exceeded more than 35 times in a calendar year.

8.37 For rural areas, such as those surrounding the application site, the primary source of deposited dust would be local agricultural or rural based activities. As there are no major sources of deposited dust in close proximity to the proposed development, baseline levels of deposited dust would therefore be expected to be low.

Site Specific Dust Monitoring

8.38 Dust monitoring was conducted at the application site using the 'Bergerhoff method' referred to in the TA Luft Air Quality Standard. The deposition gauge used in the survey was the 'Bergerhoff' dust gauge, which comprises a plastic collection bottle and a post with protective basket, set at 1500mm above ground level. The input of the atmospheric material into the bottle is determined over a planned period measurement (usually one month) by exposing the plastic collection bottle to the environment. The total dust collected in the bottle is expressed as deposition of insoluble particulate matter (mg/m^2/day) arising from fugitive actions in the area surrounding the application site.

8.39 Baseline surveys were undertaken as part of this assessment in period from March 2015 to April 2015; refer to Figure 8-1 for baseline monitoring locations.

Study Area

8.40 The proposed inert soil waste recovery facility is located within an existing quarry located on the lower western slopes of the Sugar Loaf Mountain. The area to be backfilled / in-filled comprises a deep, steep sided void and extends across the full plan area of the former quarry.

8.41 The western extent of the application site is bound by the R755 Regional Road between Kilmacanoge and Roundwood. The regional road lies up-slope from the Killough River which marks the boundary between the west-facing slope of the Sugar Loaf and the east-facing slope of Long Hill. To the north, the landscape levels out to form a coastal plain towards Bray. To the south, the river valley forms a plateau towards Roundwood.

[2] Secure Archive For Environmental Research Data – http://erc.epa.ie/safer/.

8.42 Roadstone's total landholding at Calary Quarry extends to approximately 25.4hectares (61.2 acres). The plan footprint of the application sit, including perimeter screening bunds and engineering site infrastructure extends to approximately 9.1hectares (21.9 acres)

Surrounding Land use

8.43 The lands surrounding the application site and existing quarry comprise rough grazing land and gorse, interspersed with patches of bracken. It is divided into several small fields by stonewalls, fences and hedgerows.

8.44 The proposed recovery facility will be located immediately west (and down-gradient) of a proposed Natural Heritage Area (NHA) at the Great Sugar Loaf (Site Code 001769). This site is designated on the basis of the presence of mountain heath and upland grassland. The site has not however been proposed as a candidate Special Area of Conservation (cSAC).

8.45 The existing quarry currently comprises steep, bare, largely un-vegetated or naturally colonised soil and rock slopes and a surface water body which has formed within the quarry void by capture of natural drainage (surface run-off from surrounding sloping ground and rainfall).

8.46 There are no trees or hedgerows or other habitat in the vicinity of the application site that will be adversely affected by the planned waste recovery activities.

8.47 Dwellings within the vicinity of the site generally comprise farmsteads, one off housing and ribbon development along the primary and local road network. The nearest dwellings to the landholding site boundary are those located to the south, west, and north of the site, identified on Figure 8-1.

Sources of Information

8.48 A desk study was carried out to examine all relevant information relating to air quality conditions around the application site. Met Eireann, the National Meteorological Service, was consulted in relation to the climate / weather data in respect of the study area.

8.49 Information published on its website by the National Parks and Wildlife Service (NPWS) (part of the Department of the Environment, Community and Local Government, DoECLG), in respect of designated ecological sites, protected habitats and species was also reviewed, together with Ordnance Survey maps and aerial photography.

Monitoring / Inspection

8.50 Baseline dust deposition monitoring results recorded at the existing quarry during March 2015 are reviewed as part of this assessment. A survey of the extent of existing residential housing in the area of the quarry was also undertaken.

Dust Deposition Monitoring Locations and Results

8.51 The location of the dust deposition monitors are shown on Figure 8-1:

D1 – Located at the southern boundary
D2 – Located at the northern boundary
D3 – Located at the western boundary

8.52 The results of the dust deposition monitoring (March 2015) are presented in Table 8-2 below.

Table 8- 2
Dust Deposition Monitoring Results

Month	D1 (mg/m^2/day)	D2 (mg/m^2/day)	D3 (mg/m^2/day)
02/03/15 – 8/04/15	1	25	5

8.53 The above dust monitoring results indicate that the dust deposition levels at the existing quarry void are low.

Meteorology : Dispersion of Emissions

8.54 The most important climatological parameters governing the atmospheric dispersion of particles are as follows:

- wind direction: determines the broad transport of the emission and the sector of the compass into which the emission is dispersed; and
- wind speed will affect ground level emissions by increasing the initial dilution of particles in the emission. It will also affect the potential for dust entrainment.

8.55 Rainfall is also an important climatological parameter in the generation of dust; sufficient amounts of rainfall can suppress dust at the source and eliminate the pathway to the receptor. According to Arup (1995)[3] rainfall greater than 0.2mm per day is sufficient to suppress dust emissions.

Local Wind Speed and Direction Data

8.56 The closest weather station with sufficient records of wind direction and wind speed considered representative of conditions experienced at the application site is Baldonnel (Casement) Aerodrome Meteorological Station, which is located approximately 38 km to the north-west of the application site.

8.57 A windrose for the average conditions recorded at Baldonnel (Casement) Aerodrome, over a ten year period, is presented in Figure 8.2. The predominant wind direction is from the south western quadrant.

Rainfall data

8.58 Relevant rainfall data applicable to the site has been obtained from the Irish Meteorological Service website for the Baldonnel (Casement) Aerodrome station (2003 – 2013), approximately 38 km north-west of the quarry. The annual average days with rainfall greater than 1 mm is 130 days per year.[4] Natural dust suppression (from rainfall) is therefore considered to be effective for 36% of the year.

[3] Arup Environmental. Environment Effects of Surface Mineral Workings. UK DoE, October 1995
[4] http://www.met.ie/climate-ireland/1971-2000/casement.html

Dust Sensitive Receptors

Ecological Receptors

8.59 The application site is not subject to any statutory nature conservation designation. The Great Sugar Loaf proposed Natural Heritage area (pNHA – Site Code 001769) borders with the site boundary to the east of the application site (refer to Figure 8-1).

8.60 The main tourism / amenity in the vicinity of the quarry is the Great Sugar Loaf mountain itself, located upslope and east of Calary Quarry.

Human Receptors

8.61 Sensitive locations are those where people may be exposed to dust from the planned site activities. Locations with a high sensitivity to dust include hospitals and clinics, hi-tech industries, painting and furnishing and food processing. Locations classed as being moderately sensitive include schools, residential areas and food retailers.

8.62 Receptors have been identified within a 1km distance of the overall planning application boundary. This is a cautious approach, as the dust generating activities are located at greater distances within the site. These receptors are listed in Table 8-3 and their locations is indicated in Figure 8-1. As housing is clustered in some areas, receptors have been identified at the nearest location to the application site boundary.

Dust Sensitive Receptors

8.63 There are 20 sensitive receptors identified within the 1km study area of the planning application area. A summary of the closest dust sensitive receptors in each direction surrounding the planning application area and their respective proximity to the nearest dust generating activity within the site is presented in Table 8-3 below.

Table 8- 3
Dust Sensitive Receptors within 1km

Receptor Reference	Receptor	Sensitivity	Distance (m) / Direction from site activities
1	Residential/Commercial	Medium	210(S)
2	Residential/Commercial	Medium	195(S)
3	Residential	Medium	240(S)
4	Residential	Medium	225(S)
5	Residential	Medium	400(SW)
6	Residential	Medium	195(W)
7	Residential	Medium	250(W)
8	Residential	Medium	260(W)
9	Residential	Medium	270(W)
10	Residential	Medium	340(W)
11	Residential	Medium	355(NW)

Receptor Reference	Receptor	Sensitivity	Distance (m) / Direction from site activities
12	Residential	Medium	400(NW)
13	Residential	Medium	540(NW)
14	Residential/Commercial	Medium	600(N)
15	Residential	Medium	670(N)
16	Residential	Medium	690(N)
17	Residential	Medium	725(N)
18	Residential	Medium	800(N)
19	Residential	Medium	890(N)
20	Ecology/Recreational	Medium	0(E)

Difficulties Encountered

8.64 This assessment is compiled on the basis of published regional and local data, guidance documents, and site-specific field surveys. No difficulties were encountered in compiling the required information.

IMPACT ASSESSMENT

Evaluation Methodology

8.65 A semi-quantitative assessment of fugitive dust emissions from the proposed waste recovery facility has been undertaken. The assessment has been undertaken by constructing a conceptual model that takes into consideration the potential sources, surrounding receptors, and the pathway between source and receptor in order to assess the magnitude of risk of impact on local amenities.

8.66 The distance from the source to the sensitive receptor is crucial. The initial risk screening stage (Tier 1) focuses upon the potential for dust generation at the site and the distance between source and receptors. In Tier 1 of the assessment, a representative selection of dust sensitive receptors in each direction of the application site is identified within the 1km study area.

8.67 Further assessment is considered to be required for those receptors within 500m of dust generating activities. Receptors within 500m of dust generating processes progress onto a Tier 2 assessment.

8.68 Tier 2 involves identifying source-pathway-receptor linkages and a semi-quantitative assessment of the likelihood and magnitude of any effects that could be associated with each pollutant linkage. This assessment takes account of:

- wind direction and speed data (to estimate frequency of exposure);
- proximity to source (to estimate magnitude of exposure);
- sensitivity of receptor; and
- occurrence of natural dust suppression (rainfall patterns).

8.69 This information is used to inform a semi-quantitative assessment of the likely magnitude of impact and is based upon professional experience of the assessor as the issue of dust nuisance on local receptors is a subjective issue, where public perception on what constitutes ‘acceptable’ levels varies from one person

to the next. Assigning significance to nuisance impacts is qualitative and involves a judgement based on the likely magnitude, frequency, duration and reversibility (or recovery) of the impact. In this context, significant impact is taken to mean what is generally not publicly acceptable and desirable.

8.70 This assessment does not take into account mitigation measures implemented at the proposed development. These include provision of perimeter screening berms, dust suppression measures etc., refer to the Mitigation Measures identified later in this chapter.

8.71 Following the results of the risk assessment, mitigation measures are detailed and the residual impact assessed. The detailed methodology used within the assessment is described in Appendix 8-A.

Sources of Dust

8.72 There are a number of sources of dust generation within the proposed waste recovery facility at Calary Quarry. The main potential sources of dust include stockpiles, traffic on internal haul roads, all of which are generally area sources rather than specific point sources. Other sources of dust include the deposition of dust on public roads and the release of suspended dust particles from vehicle exhaust emissions.

8.73 The activities assessed in this study are as follows:

- importation of inert soil waste from external sources (construction sites);
- soil handling (stockpiling, placement and compaction of inert and site-won soil);
- placement of minor quantities of imported aggregate along temporary haul roads;
- stockpiling of topsoil pending final surface restoration works.

8.74 The dust sources introduced by handling, placement and stockpiling of soils and traffic movement over haul routes are considered to be the most significant sources of suspended particulate matter emissions, with emission rates of all other particles considered to be insignificant[5].

Transport : Access Roads

8.75 Particulate emissions from road surfaces are primarily due to re-suspension of loose material present on the road surface and the additional deposition of material from the under carriage of passing vehicles. The access road leading into and out of the application site is paved to minimise this as a source of dust during vehicle passage.

8.76 The potential for dust emissions from paved road surfaces are significantly less when compared to unpaved surfaces, due to the fact that the road base does not erode. On paved surfaces instances, the main factor in the production of dust emissions is the deposition of dust from passing vehicles. It is considered that the length of paved road surface between the in-site area and the local public road network is of sufficient length for any deposited materials to fall from the vehicle prior to entering the local road network (notwithstanding the proposed installation of a new wheelwash facility at the application site).

[5] Chaulya, S.K. et al. 2001. Air Pollution Modelling for a Proposed Limestone Quarry, Water, Air and Soil Pollution 126: 171-191, 2001.

8.77 A study on air pollution for a quarry concluded that paved roads do not introduce a major source of dust emissions; whereas the fugitive dust generated from vehicles across unpaved surfaces requires assessment[5].

Transport : Internal Haulage Routes

8.78 The potential for dust emissions from unpaved haul roads is dependent on the average weight, speed, and number of wheels in contact with the road surface. Particulate emissions from unpaved roads have been found to be higher at greater vehicular speeds[6]. In addition to the generation of dust from the passage of vehicles, any loose dust across the road surface can also become entrained by wind blow, with the potential to lift dust from surfaces, depending on wind speeds, the conditions of the road surface and the size of dust particles.

Soil Handling

8.79 The handling of soil has the potential for a substantial temporary impact on the local air quality. The potential for dust emissions would vary considerably from day to day, depending on the level of activity, the specific operation, the location of the activity and the prevailing meteorological conditions.

8.80 The handling and transportation of soils are intensive, albeit short term operations, with a substantial potential for dust emissions in the absence of mitigation measures. A high potential for dust generation occurs during the tipping of soils onto the ground during stockpiling and in the soil placement and compacting activities undertaken as part of the quarry backfilling and restoration works.

Risk of Impacts

Tier 1 : Risk Screening

8.81 Table 8-3 identifies receptors within the 1km study area around the application site. There are 19 receptors rated as being of medium sensitivity within 1km of the site boundary.

8.82 Using the tiered assessment methodology, receptors located within 500m have progressed onto a Tier 2 assessment as they are considered to have a greater risk of dust impact. Those receptors that are assessed within Tier 2 are detailed below in Table 8-4.

[6] Williams, D.S et al, 2008. Particulate matter emissions by a vehicle running on unpaved roads. Atmospheric Environment (2008), doi:10.1016/j.atmosenv.2008.02.003

Table 8- 4
Receptors Progressing to Tier 2

Receptor Reference	Receptor	Sensitivity	Distance (m) / Direction from Site Activities (approx.)
1	Residential/Commercial	Medium	210(S)
2	Residential/Commercial	Medium	195(S)
3	Residential	Medium	240(S)
4	Residential	Medium	225(S)
5	Residential	Medium	400(SW)
6	Residential	Medium	195(W)
7	Residential	Medium	250(W)
8	Residential	Medium	260(W)
9	Residential	Medium	270(W)
10	Residential	Medium	340(W)
11	Residential	Medium	355(W)
12	Residential	Medium	400(NW)
20	Ecology/Recreational	Medium	0(E)

Tier 2 : Semi-Quantitative Assessment

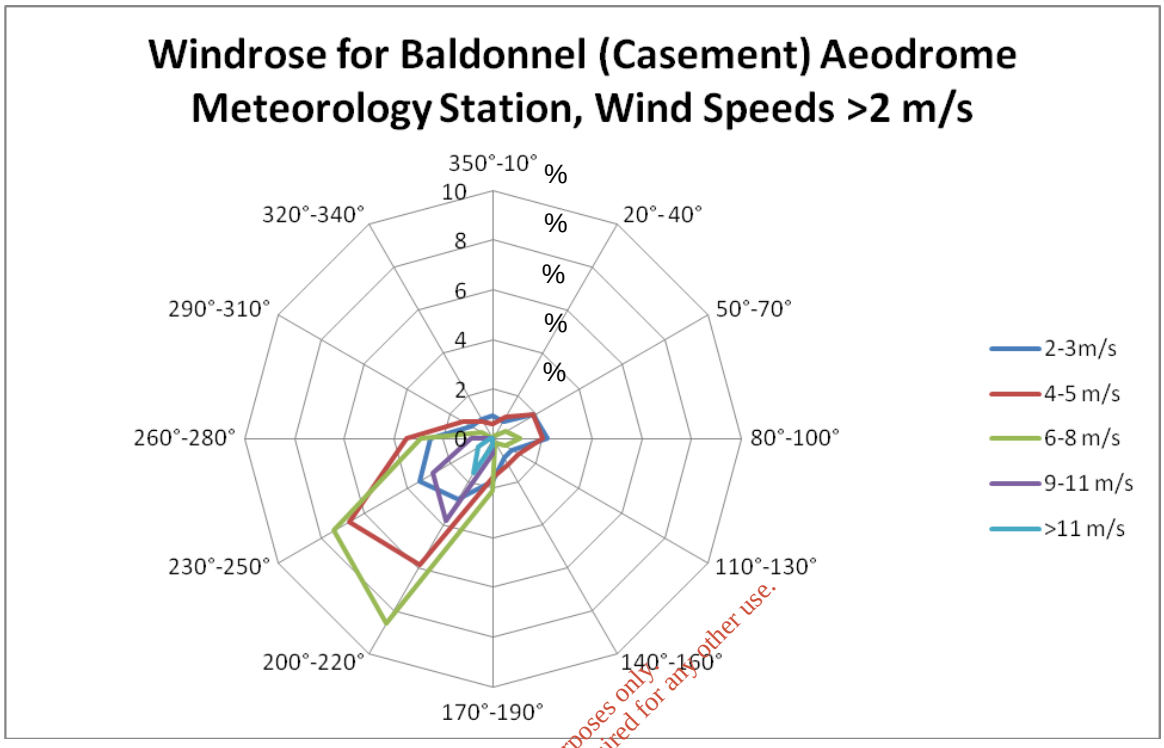
8.83 Each receptor identified in Table 8-4 above is assessed against the frequency of exposure and the distance from the source to the receptor (i.e. the pathway). The methodology is described fully in Appendix 8-A.

8.84 The frequency of exposure of each receptor is based upon the frequency of winds capable of carrying dust particles blowing in the direction, from the source to the receptor, on days when rainfall does not inhibit dust from becoming airborne. Representative data on the local wind climate is therefore required for this section of the assessment.

8.85 A wind-rose for the site is presented in Figure 8-2 for Baldonnel (Casement) Aerodrome Meteorological Station and illustrates the predominant wind directions from the south-west. The potential for the generation of airborne dust will increase with wind speed, with winds greater than 3 m/s capable of carrying airborne dust[7]. A wind rose showing the frequency of winds at wind speeds of greater than 2 m/s is presented in Figure 8-2 with the individual frequencies for each 30 degree compass sector used within the assessment. In this assessment, wind speeds over 2 m/s were used; as this is how the data on percentage occurrence of wind frequency and wind speed is calculated and presented by Met Eireann. For this reason therefore, the impact assessment presented herein is conservative.

[7] Department of the Environment, Transport and the Regions, 1995. *The Environmental Effects of Dust from Surface Mineral Workings* – Volume 2. Technical Report. December 1995.

Figure 8-2
Windrose for Baldonnel (Casement) Aerodrome Meteorology Station
High Wind Speeds (> 2 m/s)



8.86 A summary of the risk assessment of dust impacts from sources within the proposed development is presented in Table 8-5 below.

Table 8- 5
Dust Risk Assessment (Without Mitigation Measures)

Receptor Reference	Risk Evaluation
1	Insignificant
2	Insignificant
3	Insignificant
4	Insignificant
5	Insignificant
6	Insignificant
7	Acceptable
8	Acceptable
9	Acceptable
10	Insignificant
11	Insignificant
12	Insignificant
20	Moderate Adverse

Refer to Figure 8-1 for Receptor Locations / Appendix 8-B for Dust Risk Assessment Calculations

8.87 From Table 8-5, it is observed that the risk of impact from dust emissions associated with the proposed soil waste recovery facility at Calary Quarry (without any mitigation measures in place) generally varies from insignificant to acceptable at residential receptors within 500 meters of the dust generating activities, apart from Receptor 20, when the risk of impact from dust emissions is evaluated to be moderate adverse.

Risk of Impacts: Ecological Receptors

8.88 The application site is not subject to any statutory nature conservation designation.

8.89 The nearest protected site, located immediately east of the application site, is a proposed Natural Heritage Area (pNHA) at the Great Sugar Loaf (Site Code 001769). This site is designated on the basis of the presence of mountain heath and upland grassland. The site has not however been proposed as a candidate Special Area of Conservation (cSAC).

8.90 Studies have indicated that fugitive dust from quarry sites is typically deposited within 100m to 200 m of the source; the greatest proportion of which, comprising larger particles (greater than 30 microns) is deposited within 100m[8]. Where large amounts of dust are deposited on vegetation over a long time-scale (a full growing season for example), there may be some adverse effects upon plants restricting photosynthesis, respiration, and transpiration.

8.91 A baseline dust deposition monitoring at Calary Quarry indicates that the levels of dust generated from existing quarry are currently low, and well below the level of 1000 mg/m^2/day[9] [10], where it is considered that dust could be likely to have a significant effect on sensitive ecosystems.

8.92 It is predicted that dust deposition from the operation of the inert soil recovery facility and backfilling of the quarry void will not exceed 350mg/m^2/day, in accordance with EPA guidelines for dust deposition at extractive sites, and well below the level of 1000 mg/m^2/day where it is considered that dust could be likely to have a significant effect on sensitive ecosystems.

8.93 The habitats within the Great Sugar Load pNHA immediately adjacent to the application site have been subject to varying levels of dust deposition from former quarrying operations. This would indicate that the habitats and supporting flora present are pretty tolerant and resilient to historical deposition of dust arising from the application site. As indicated in Chapter 4 of this EIA (Ecology), none of the habitats present within the potential zone of influence of the proposed inert soil recovery facility (up to 500m radius) are considered to be sensitive to dust deposition.

8.94 On the basis of the above, it is concluded that the proposed inert soil recovery facility will have no significant impact on Great Sugar Loaf pNHA or ecological receptors from the deposition of fugitive dust.

[8] UK Department of the Environment (1995). *The Environmental Effects of Dust from Surface Mineral Workings. Volume 1: Summary Report & Best Practice Guides.* HMSO.

[9] Farmer, A.M. (1993). *The Effects of Dust on Vegetation – A Review*. Environmental Pollution Vol.79, Issue 1, Pages 63-75.

[10] Highways Agency (2007). Design Manual for Roads and Bridges Volume 11, Section 3, Part 1 HA207/7 Air Quality. Highways Agency.

Risk of Impacts: Human Receptors

8.95 Earth moving and compaction activities can generate dust, particularly in dry weather conditions. Using a screening assessment tool, the Air Quality Assessment (outlined in Appendix 8A) considers that there is generally an insignificant to acceptable risk that dust may cause an impact at sensitive receptors within 500m of the source of the dust generated activities, apart from Receptor 20, where the risk of impact from dust emissions is evaluated to be moderate adverse.

8.96 Note that this assessment *does not take into account implementation of mitigation measures* within the proposed development that include provision of perimeter screening berms, dust suppression measures etc. (outlined in the Mitigation Measures section below). This assessment is considered to be conservative on the basis of the moderate wind speeds included in the risk evaluation.

8.97 In the absence of mitigation measures, Receptors 1, 2, 3, 4, 5, 6, 10, 11, and 12 are assessed to have an insignificant risk of dust impact from the proposed development, while Receptors 7, 8, and 9 are assessed to have an acceptable risk of dust impact from the proposed development.

8.98 In the absence of mitigation measures, Receptor 20 is however assessed to have a moderate adverse risk of dust impact from the proposed development.

Traffic Emissions

8.99 Apart from the restoration and recovery activities at the application site, the only other significant source of air pollution in the vicinity of the application site is traffic along the existing local road network. Many of the pollutants emitted by motor vehicles are also produced by a wide range of other industrial and domestic processes.

8.100 Data from the EPA (Ireland's Environment – A Millennium Report) indicates that road transport sources produced most of the emissions of Carbon Monoxide (81%) and substantial amounts of hydrocarbons (VOC 60%), oxides of nitrogen (NO_x 50%) and Carbon Dioxide (11%). Data from the UK Department of the Environment, Transport and the Regions (Digest of Environmental Statistics No. 20) indicates that the quantity of PM_{10} emissions (ie. particles with a diameter of 10µm or less) due to traffic is of the order of 28%.

8.101 While no site-specific PM_{10} levels have been measured at the application site, some limited, historical air quality monitoring at the (former) Bray Town Council yard at Bray suggests that PM_{10} concentrations at that location fall within permissible air quality limits (exceedance of daily limit of 50 ug/m^3 on 0 days per year). Given that the application site is located in a more rural area, this suggests that existing ambient PM_{10} concentration is highly unlikely to present cause for concern and is unlikely to be adversely impacted by the proposed recovery activities at the application site.

MITIGATION MEASURES

8.102 A large range of mitigation measures are recommended for implementation at the proposed recovery facility at Calary Quarry. The principal factor which will reduce and mitigate emissions from recovery activities will be the working within the existing quarry void, below surrounding ground level, with the high quarry faces effectively inhibiting emission of fugitive dust off-site.

8.103 In addition to this however, a number of other measures are outlined below which will further reduce or mitigate potential dust impacts from the proposed development.

Dust Minimisation at Source

8.104 When adverse conditions apply (dry, windy weather), water from a bowser should be sprayed on dry unpaved haul road surfaces in order to minimize dust rise.

8.105 Backfilled excavations and topsoil capping should be grassed as soon as practicable after completion of soil placement.

8.106 Stockpiling of imported soils should be minimized. Soils should ideally be placed and compacted in-situ immediately after being unloaded. If and when temporary stockpiling of soils is required, they should be placed against quarry faces, as far as possible from nearby residences.

8.107 In order to reduce the potential for dust emissions, the area of bare or exposed soil should, insofar as practicable, be kept to a minimum. In the unlikely event that future monitoring indicates that dust emissions are excessive or problematic, consideration could be given to establishing vegetation cover over temporary slopes and stockpiles pending final backfilling and restoration to original ground level.

8.108 Mobile water bowsers should be used to dampen down particulate materials from operations or stockpiles, as and when required, principally in windy periods during extended dry spells.

8.109 Where necessary to enhance site security and/or visual screening, enhanced fencing and perimeter planting is to be undertaken at Calary Quarry as part of the proposed development. Any additional security / screening by vegetation would also be expected to provide some minor additional dust screening benefits.

Traffic

8.110 In order to minimise dust emissions from traffic along unpaved haul roads through the application site, it is recommended that they be constructed of imported aggregate. These materials should have a very low silt content (similar to that of Class 6F1 or Clause 804 material as per the NRA Specification for Road Works) and should be adequately compacted in order to minimise dust rise. The haul roads should have a minimum compacted thickness of 150mm of granular material.

8.111 When adverse conditions apply (dry, windy weather), water from a bowser should be sprayed on dry unpaved road surfaces in order to minimize dust rise. Paved road surfaces around the site infrastructure area and the access road leading out of the site should also be sprayed. In the unlikely event that future monitoring indicates that dust emissions are excessive or problematic, consideration could be given to installing an automated sprinkler system along site roads to dampen any lying dust.

8.112 All heavy goods vehicles leaving the application site will be routed through the proposed wheelwash facility in order to remove and/or dampen any dust / clay material attaching to the undercarriage and to prevent transport of fine particulates off-site, onto the local public road network.

RESIDUAL IMPACT

8.113 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 7,8 and 9 from the proposed development reduces from acceptable (within mitigation measures in place) to insignificant.

8.114 With the range of mitigation measures to be implemented and design measures to incorporated into the working scheme it is considered that the risk dust impact at Receptor 20 from the proposed development reduces from moderate adverse (without mitigation measures in place) to acceptable.

8.115 On the basis of the assessment presented above, it is concluded that the proposed development, with the range of mitigation measures to be implemented and design measures incorporated into the working scheme, will not have a dust deposition impact on assessed receptors.

CUMULATIVE IMPACT

8.116 There no other significant sources of emission to air within close proximity to the site and therefore no potential for significant cumulative impacts has been identified.

INTERACTION WITH OTHER IMPACTS

8.117 The potential impact on air quality by the project on sensitive receptors including sensitive ecological receptors and people living in the area has been fully assessed in this chapter. The overall impact of the project on these receptors is further considered in Chapter 3 Human Beings and Chapter 4 Ecology.

MONITORING REQUIREMENTS

8.118 Dust deposition monitoring will be undertaken at the application site. Dust monitoring locations shall be reviewed and revised where and as/when necessary. The results of the dust monitoring shall be submitted to the EPA and Wicklow County Council on a regular basis for review and record purposes.

APPENDIX 8-A
DUST RISK SCREENING ASSESSMENT METHODOLOGY

Appendix 8A Risk Screening Assessment Methodology

The methodology applied in the assessment is a semi-quantitative risk assessment methodology, in which the probability of an impact occurring and the magnitude of the impact, if it were to occur, are considered. This methodology is the Tier 2 assessment of the dust assessment methodology. In the event that identified dust sensitive receptors are not screened out within Tier 1, this approach provides a mechanism for identifying the areas where mitigation measures are required, and for identifying mitigation measures appropriate to the risk presented by the development (i.e. the assessment does not take account of existing mitigation in place at the quarry.).

The magnitude of the potential risk at each receptor is classified depending on the frequency of exposure and the distance from the site to the receptor. Frequency of exposure is represented by the percentage of moderate to high winds (over 3m/s) from the direction of the site.

The screening assessment tool assesses the significance of the distance from site and the frequency of exposure of each receptor by assigning a ranked number. Receptors with a higher potential for dust impacts would therefore result in a higher value whilst receptors with lower potential would expect to carry a lower value. The value corresponding to an evaluation of risk is a product of the significance of the distance and frequency of exposure, each is assigned a value representing its significance. The multiplication of the two values assigned gives a total, which is then corresponded to a qualitative term of risk magnitude.

Frequency of Exposure Criterion

The potential for any site to emit dust is greatly influenced by weather. Increased wind speed increases the potential for the generation of airborne dust due to the suspension and entrainment of particles in airflow. A worst case situation would be strong, warm, drying winds which increase the rate at which dust is lifted from an untreated surface and emitted into the air. Wind can also have the effect of spreading dust over a large area. Conversely, rainfall decreases dust emissions, due to both surface wetting and increasing the rate at which airborne dust is removed from air. An article on dust generation from quarry operations[11] suggests that rainfall of greater than 0.2mm per day is considered sufficient to effectively suppress wind blown dust emissions.

The frequency of exposure to dust emissions represents the percentage of time that wind speeds capable of carrying airborne dust (greater than 3m/s) are blowing from the site to the direction of the receptor. Frequencies are calculated based on meteorological data. For screening assessment wind speeds greater than 2m/s were considered as this is how data on percentage occurrence of wind frequency and wind speed is calculated and presented by Met Eireann. For this reason assessment is considered to be conservative.

For the screening assessment, a value of 1mm would be used for the criteria to classify days as ‘dry’ or ‘wet’; five times the recommended value, using annual average rainfall data. The average number of days when rainfall exceeds 1.0mm would be provided for each month, and calculated over the year to provide an average.

The resulting frequency of moderate to high wind speeds with the potential of carrying airborne dust towards receptors would then be classified into the criteria in Table 8A-1 with the respective rank value assigned.

[11] Leeds University. Good Quarry. http://www.goodquarry.com/article.aspx?id=55&navid=2

Table 8A- 1
Frequency of Exposure – Risk Classification

Risk Category	Criteria
1	Frequency of winds (>2 m/s) from the direction of the dust source on dry days are less than 3%
2	The frequency of winds (>2 m/s) from the direction of the dust source on dry days are between 3% and 6%
3	The frequency of winds (>2 m/s) from the direction of the dust source on dry days are between 6% and 9%
4	The frequency of winds (>2 m/s) from the direction of the dust source on dry days are between 9% and 12%
5	The frequency of winds (>2 m/s) from the direction of the dust source on dry days are between 12% and 15%
6	The frequency of winds (>2 m/s) from the direction of the dust source on dry days are greater than 15%

Distance to Source Criterion

In assessing dust impacts, the distance from the source to the sensitive location is crucial, as airborne and deposited dust tend to settle out close to the emission source. Smaller dust particles remain airborne for longer, dispersing widely and depositing more slowly over a wider area.

Guidance indicates that larger dust particles (greater than 30µm) will largely deposit within 100m of sources. Smaller particles (less than 10µm) are only deposited slowly. Concentrations decrease rapidly on moving away from the source, due to dispersion and dilution.

To allow for this effect of distance, buffer zones are often defined by mineral planning authorities around potentially dusty activities to ensure that sufficient protection is provided. They have not been established in any rigorous scientific way, but usually range from 50m to 200m. The 1995 UK DoE Guidance on dust from surface mineral working's, however, recommends a stand-off distance of 100-200m from significant dust sources (excluding short-term sources), although it is recognised that these distances can be reduced if effective mitigation measures are identified and implemented. In terms of identifying sensitive locations therefore, and to represent an extreme worst case scenario, consideration only needs to be given to sensitive receptors within 500m of the site boundary. Receptors at a distance greater than 500m have therefore been screened out in Tier 1 of the assessment.

The criteria for classifying the distance from receptor to source and thus assigning a rank value has therefore been based on the various references to dust behaviour described above. The rank classifications are presented below in Table 8A-2. A risk category is maintained for receptors in excess of 500m for circumstances where although a receptor is beyond 500m from the dust source, its sensitivity for example is sufficient for it to be taken onto a Tier 2 assessment.

Table 8A- 2
Distance to Source – Risk Classification

Risk Category	Criteria
1	Receptor is more than 500m from the dust source
2	Receptor is between 400m and 500m from the dust source
3	Receptor is between 300m and 400m from the dust source
4	Receptor is between 200m and 300m from the dust source
5	Receptor is between 100m and 200m from the dust source
8	Receptor is less than 100m from the dust source

Sensitivity of Receptors

Sensitive locations are those where the public may be exposed to dust from the site. Locations with a high sensitivity to dust include hospitals and clinics, hi-tech industries, painting and furnishing and food processing. Locations classed as being moderately sensitive include schools, residential areas and food retailers. Table 8A-3 below[12] shows examples of dust sensitive facilities.

Table 8A- 3
Examples of Dust Sensitive Facilities

High Sensitivity	Medium Sensitivity	Low Sensitivity
Hospitals and clinics	Schools and residential areas	Farms
Retirement homes	Food retailers	Light and heavy industry
Hi-tech industries	Greenhouses and nurseries	Outdoor storage
Painting and furnishing	Horticultural land	
Food processing	Offices	

Evaluation of Risk

Once a rank value has been assigned to the frequency of exposure and distance to source, an overall risk can be evaluated by combining the two risk categories, along with consideration of the sensitivity of the receptor. For low sensitivity receptors the risk of dust impact are considered to be significantly lower than for medium and high sensitive receptors. Therefore a factor of 0.5 would be applied to the final risk evaluation ranking.

For each receptor, the relative magnitude of risk is given by identifying which of the score categories in Table 8A-4 it falls into. This final evaluation represents the risk of dust impacts prior to control and mitigation measures being employed on site.

Table 8A- 4
Risk Evaluation Ranking (Without Mitigation)

Magnitude of Risk	Score
Insignificant	7 or less
Acceptable	8 to 14
Slight Adverse	15 to 24
Moderate Adverse	24 or more

[12] **Ireland M. (1992)** "Dust: Does the EPA go far enough?", Quarry Management, pp23-24.

APPENDIX 8B
DUST RISK SCREENING RESULTS
(RECEPTORS WITHIN 500M OF SOURCE)

Appendix 8-A
Dust Risk Screening Results (Receptors within 500m of Dust Source)

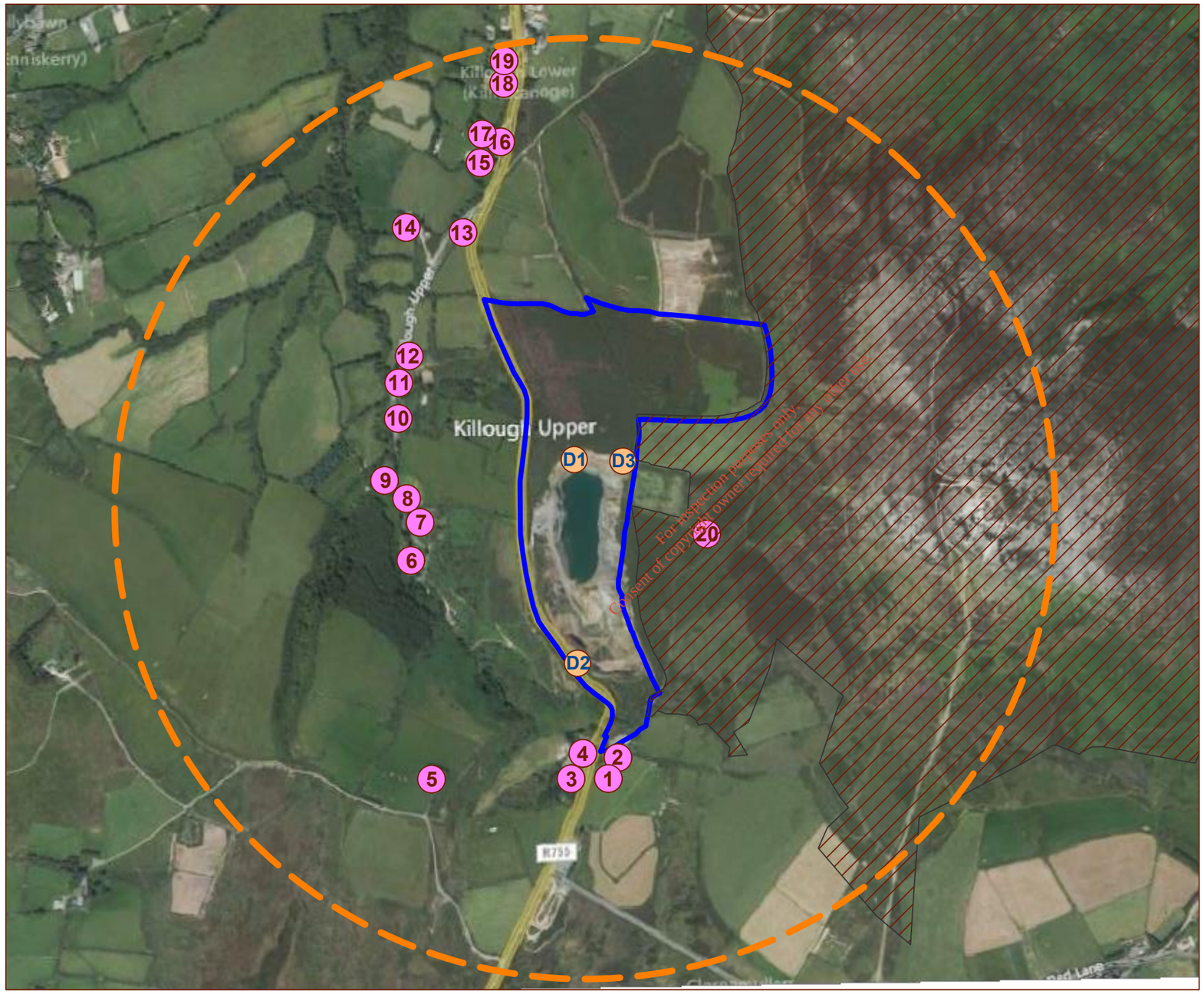
Receptor Reference	Receptor	Sensitivity	Distance from site activities (approx.)	Relevant Wind Direction	Potential Exposure Duration (adjusted for dry days only)[a]	Relative Wind/ Distance Rank	Multiplied Rank	Risk Evaluation (Without Mitigations)
1	Residential / Commercial	Medium	210(S)	350-10	0.96	1/4	4	Insignificant
2	Residential/ Commercial	Medium	195(S)	350-10	0.96	1/5	5	Insignificant
3	Residential	Medium	240(S)	350-10	0.96	1/4	4	Insignificant
4	Residential	Medium	225(S)	350-10	0.96	1/4	4	Insignificant
5	Residential	Medium	400(SW)	20-40	1.2	1/2	2	Insignificant
6	Residential	Medium	195(W)	50-70	2.8	1/5	5	Insignificant
7	Residential	Medium	250(W)	80-100	3.3	2/4	8	Acceptable
8	Residential	Medium	260(W)	80-100	3.3	2/4	8	Acceptable
9	Residential	Medium	270(W)	80-100	3.3	2/4	8	Acceptable
10	Residential	Medium	340(W)	110-130	1.7	1/3	3	Insignificant
11	Residential	Medium	355(W)	110-130	1.7	1/3	3	Insignificant
12	Residential	Medium	400(NW)	110-130	1.7	1/2	2	Insignificant
20	Ecology / Recreational	Medium	0(E)	260-280	6.3	3/8	24	Moderate Adverse

[a] Based on the frequency of moderate to high winds (>2 m/s) which would cause dust emissions to travel in the direction of the receptor. Adjusted for natural suppression due to 36% days with rainfall over 1mm (Factor = 0.64)

Note: This assessment does not take into account proposed mitigation measures that include provision of perimeter screening berms, dust suppression measures etc., refer to Mitigation Measures section

FIGURES

Figure 8-1
Dust Monitoring - Receptor Locations



0 100 200 300 400m 600 800 1000

Metres 1:10,000

NOTES

1. ORDNANCE SURVEY IRELAND LICENCE NO. **SU 0000716 (C)** ORDNANCE SURVEY IRELAND & GOVERNMENT OF IRELAND

2. AERIAL IMAGE EXTRACT FROM www.bing.com

LEGEND

- ROADSTONE LIMITED LAND INTEREST (c.25.45 Hectares)
- D2 — DUST MONITORING LOCATIONS
- 7 — DUST RECEPTOR LOCATIONS
- 1KM RADIUS FROM SITE
- NPWS pNHA - GREAT SUGAR LOAF (001769)

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ROADSTONE LIMITED

ENVIRONMENTAL IMPACT STATEMENT

INERT SOIL WASTE RECOVERY FACILITY

CALARY QUARRY,
KILMACANOGE, CO. WICKLOW

DUST MONITORING / RECEPTOR LOCATIONS

FIGURE 8-1

Scale	Date
1:10,000 @ A3	MAY 2016

00180.00109.0.FIG_8.1.Dust Monitoring_Recptor Locations.dwg