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Dust Assessment

Proposed reopening of Horn Crag Quarry

December, 2022

A D Calvert

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1 Introduction

1.1 Overview

A. D. Calvert Architectural Stone Supplies Ltd (Calverts) are preparing a planning application for the re-opening of a stone quarry at Horn Crag Quarry, near Silsden, Bradford; this is hereafter referred to as the proposed development.

The proposed development is located within the jurisdiction of the City of Bradford Metropolitan District Council (BMDC)) and lies well outside any declared Air Quality Management Area (AQMA).

It is proposed to extract approximately 520,000 tonnes of high-quality masonry stone over a 20 year period, to be exported at a rate of up to approximately 28,000 tonnes per annum. Stone would be extracted using an excavator and transported off-site for processing into high-quality bespoke masonry products; no blasting would be undertaken on site. The site would be restored using mineral waste from within the site only, forming a mixture of habitats and vegetation.

DustScanAQ (herein DS) have been instructed by The Mineral Planning Group Ltd, on behalf of Calverts, to undertake a Dust and Air Quality Assessment (DAQA) for submission with the application. This assessment focuses on disamenity (nuisance) and human health impacts as a result of the development and operation of the proposed quarry.

There is no standard method for carrying out DAQA for minerals sites although this report has been prepared with reference to relevant documents and best practice guidance, including the National Planning Policy Framework (NPPF) and associated Planning Practice Guidance (PPG) relating to Air Quality[1] and guidance on dust and air quality assessments for minerals sites produced by the Institute of Air Quality Management (IAQM)[2], together with guidance developed by Environmental Protection UK (EPUK) in conjunction with the IAQM[3].

1.2 Objective

The objective of the assessment is to consider potential impacts to air in relation to the pollutants identified below, and potentially arising from the proposed development.

1.3 Key pollutants

The assessment considers impacts from 'disamenity' (or 'nuisance') dust, associated with annoyance. Although there are no standards (such as AQO) for dust disamenity or annoyance, various 'custom and practice' criteria have become established.

[1] Ministry of Housing, Community & Local Government (2014). *Guidance: Air Quality.* Available at http://planningguidance.planningportal.gov.uk/blog/guidance/air-quality/
[2] Institute of Air Quality Management (2016). *Guidance on the Assessment of Mineral Dust Impacts for Planning (v1.1)*
[3] Environmental Protection UK and the Institute of Air Quality Management (2017). *Land-Use Planning & Development Control: Planning For Air Quality (v1.2)*

The assessment also considers impacts to air in relation to the national Air Quality Objectives (AQO) for PM_{10} (essentially particles less than 10 µm (micron) aerodynamic diameter), and $PM_{2.5}$ (essentially particles less than 2.5 µm aerodynamic diameter).

1.3.1 Disamenity dust

'Dust' is generally regarded as particulate matter up to 75 µm in diameter and in an environmental context can be considered in two size categories; coarser dust (particles greater than 10 µm) and fine particulate matter (PM_{10} and $PM_{2.5}$) as described above.

Coarser dust (particles greater than 10 µm) is generally regarded as 'disamenity dust' and can be associated with annoyance, although there are no official standards for dust annoyance[4]. Disamenity dust is more readily described than defined as it relates to the visual impact of short-lived dust clouds and the long-term soiling of surfaces.

Although it is a widespread environmental phenomenon, dust is also generated through many anthropogenic activities including materials handling, demolition, construction, vehicle use, arable farming and numerous industrial processes. Dust is generally produced by mechanical action on materials and is carried by moving air when there is sufficient energy in the airstream. More energy is required for dust to become airborne than for it to remain suspended.

1.3.2 Particulate matter

Particulate matter as a term refers to a mixture of solid particles and liquid droplets suspended in the air. These particles come in many sizes and shapes and can be made up of hundreds of different chemicals. Some particles, such as dust, dirt, soot or smoke, are large or dark enough to be seen with the naked eye. Others can be so small that they can only be detected using an electron microscope. Fine dust, essentially particles up to 10 microns (µm), is commonly referred to as PM_{10}.

PM_{10} is known to arise from a number of sources such as construction sites, road traffic movement, industrial and agricultural activities. Very fine particles ($PM_{0.1}$ – $PM_{2.5}$) are known to be associated with pollutants such as NO_x and sulphur dioxide (SO_2) emitted from power plants, industrial installations and road transport sources.

$PM_{2.5}$ is generally associated with combustion and traffic rather than mineral sources.

[4] Note that the expression 'nuisance dust' refers here to 'generally visible particulate matter' rather than specifically and in a legal sense to statutory nuisance, as defined in Section 79 of the Environmental Protection Act 1990.

1.4 Site setting

The proposed site covers an area of approximately 5.9 ha, although just 3.92 ha would be worked for mineral. It is located approximately 2 km northeast of Silsden, as shown in Figure 1.1 and currently consists of a former quarry (including quarry faces and vegetated mineral waste) and areas of heathland, gorse scrub, acid grassland and self-seeded trees and scrub. The site is bounded in all directions by agricultural grasslands.

There are several farmhouses and residences within 250 m of the site, including Crag House Farm to the south and Green Acres to the southwest. There are also properties along the A6034 Bolton Road to the west, including those at Cringles Park Home Estate to the northwest.

There are no statutory designated ecological sites (such as SSSIs or SACs) within 400 m of the proposed site; the nearest, South Pennine Moors SSSI and SAC, is approximately 1 km to the east, and the Nidderdale AONB is approximately 3.5 km to the northeast. Consequently, they will not be impacted by dust impacts as a result of the proposed development. The site also lies within the green belt and the White Rose Forest community forest area which encompasses North and West Yorkshire.

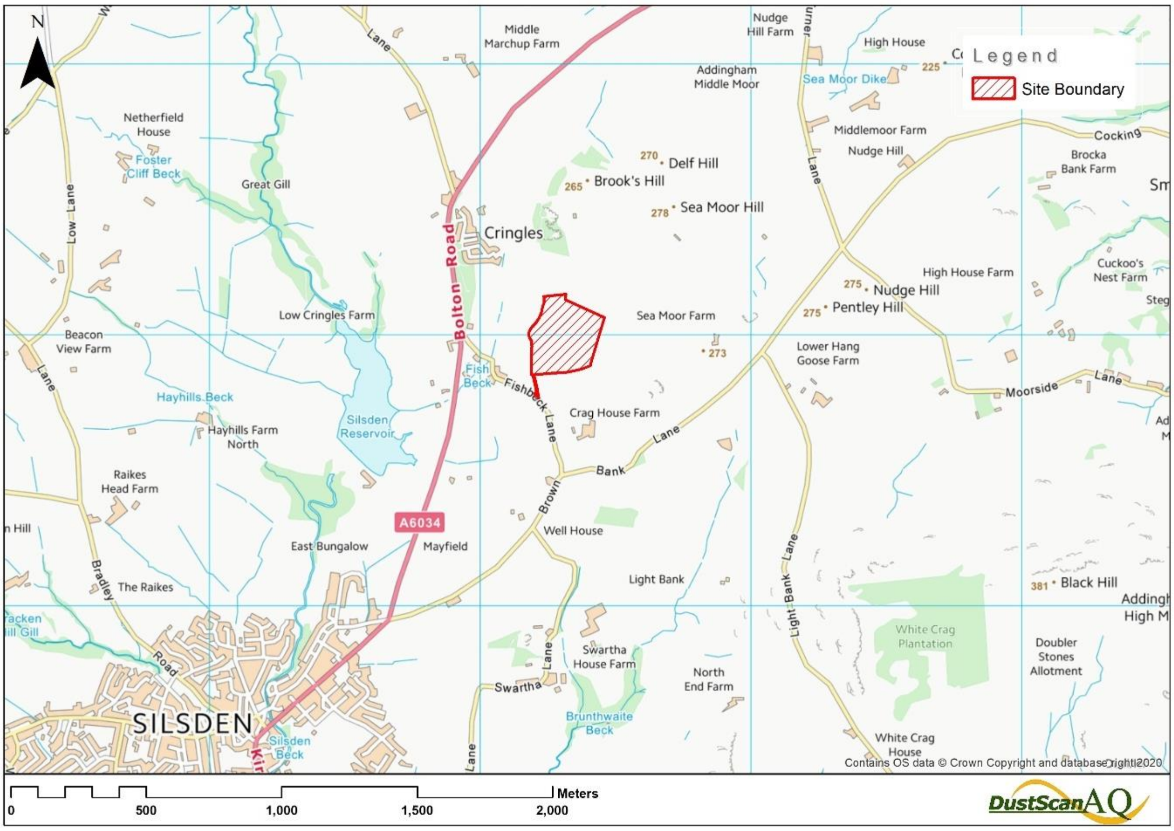

Figure 1.1: Site location

1.5 Proposed development

Full details of the proposed development are set out elsewhere, but in summary it is proposed to extract approximately 520,000 tonnes of high quality masonry stone from within a 3.92 hectare extraction area, over a 20 year period.

The site would first be prepared for extraction by creating an entrance and operational area with an office, staff parking area and an area for maintenance, turning and loading in the southwest corner of the site. Crushing and screening may be required of historic mineral waste on-site to assist with site preparation.

Mineral extraction would then be undertaken over a series of six phases, starting from west to east then progressing to the north (see Site Layout Plan). Stone would be extracted using a 360° excavator and transported on site using a front-end loading shovel. No blasting would be undertaken on site. Extracted stone would then be transported off-site to the operator's processing facility. Stone not suitable for dimension stone end-use would be retained for use in restoration.

The site would be restored using mineral waste from within the site, and would include retained faces, acid grassland, heathland, mixed and gorse scrub, wetland areas / ponds and the retention of existing biodiversity features.

The anticipated maximum hours of working shall be:

- Monday to Friday: 07.30 to 18.00;
- Saturday: 08.00 to 13.00; and
- Sunday: closed

2 Legislation, policy and non-statutory guidance

2.1 Overview

This section of the report provides the relevant legislative, policy and guidance context for the assessment of the operation.

2.2 National (England)

The 2008 EU ambient air quality directive 2008/50/EC was transposed into English law through the introduction of the Air Quality (Standards) Regulations in 2010[5] which also incorporated the fourth EU Daughter Directive (2004/107/EC) that set target values for certain toxic heavy metals and polycyclic aromatic hydrocarbons (PAH).

The UK government has a legal responsibility to meet the EU limit values. Part IV of the 1995 Environment Act[6] sets guidelines for protecting air quality in the UK and forms the basis of local air quality management. The Environment Act requires local authorities in the UK to review air quality in their area periodically and designate AQMAs where the objectives are not being achieved or are not likely to be achieved within the relevant period. Where an AQMA is designated, local authorities are also required to produce an 'Air Quality Action Plan' (AQAP) detailing the pollution reduction measures that need to be adopted to achieve the relevant air quality objectives within an AQMA.

As part of the Environment Act, the UK Government was required to publish a National Air Quality Strategy (NAQS) to establish the system of 'local air quality management' (LAQM) for the designation of AQMAs. This led to the introduction of the first Air Quality Strategy (AQS) in 1997[7] which has since progressed through several revisions until it was replaced by the Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007[8]. Each revision introduced strategies and regulations that considered measures for different pollutants by tightening existing objectives and also by introducing new ones to establish a common framework to protect human health and the environment by achieving ambient air quality improvements.

2.2.1 National Planning Policy Framework

The principal national planning policy guidance in respect of the proposed development is the National Planning Policy Framework (NPPF)[9]. The most recent update of the NPPF was published in July 2021 by the Department for Communities and Local Government (DCLG).

The NPPF 2021 contains five sections which are relevant to air quality.

Section 105 states that:

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[5] Statutory Instrument. (2010), 'The Air Quality Standards Regulations', No. 1001. Queen's Printer of Acts of Parliament.

[6] Parliament of the United Kingdom. (1990), 'Environmental Protection Act', Chapter 43. Queen's Printer of Acts of Parliament.

[7] Department for Environment Food and Rural Affairs. (1997), 'The United Kingdom National Air Quality Strategy', Cm 3587, Department for Environment Food and Rural Affairs.

[8] Department for Environment Food and Rural Affairs. (2007), 'The Air Quality Strategy for England, Scotland, Wales and Northern Ireland', Cm 7169, Department for Environment Food and Rural Affairs.

[9] National Planning Policy Framework. Accessible at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1005759/NPPF_July_2021.pdf

"The planning system should actively manage patterns of growth in support of these objectives. Significant development should be focused on locations which are or can be made sustainable, through limiting the need to travel and offering a genuine choice of transport modes. This can help to reduce congestion and emissions, and improve air quality and public health. However, opportunities to maximise sustainable transport solutions will vary between urban and rural areas, and this should be taken into account in both plan-making and decision-making."

Section 174 (e) states that:

"preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans…"

Section 185 includes

"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development…"

Section 186 states that:

"Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan."

Section 188 states that:

The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular *development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities.*

2.2.2 National Planning Practice Guidance

The DCLG published a number of supporting web-based resources of Planning Practice Guidance (PPG)[10] to supplement the NPPF. With respect to minerals the PPG[11] provides guidance on the assessment of potential dust impacts from minerals sites:

"Where dust emissions are likely to arise, mineral operators are expected to prepare a dust assessment study, which should be undertaken by a competent person/organisation with acknowledged experience of undertaking this type of work.

There are 5 key stages to a dust assessment study:

- *Establish baseline conditions of the existing dust climate around the site of the proposed operations;*
- *Identify site activities that could lead to dust emission without mitigation;*
- *Identify site parameters which may increase potential impacts from dust;*
- *Recommend mitigation measures, including modification of site design; and*
- *Make proposals to monitor and report dust emissions to ensure compliance with appropriate environmental standards and to enable an effective response to complaints."*

This assessment has been carried out with reference to the above guidance.

2.2.3 National Air Quality Strategy (NAQS)

The Air Quality Standards Regulations (AQR) prescribe national Air Quality Objectives (AQO) to be achieved for a range of pollutants. These include nitrogen dioxide (NO_2), which is usually associated with exhaust emissions from traffic, and fine particulate matter (PM_{10}), which can arise from many sources including traffic but also from industrial activities such as quarrying. The AQOs for PM_{10} and $PM_{2.5}$ are set out in Table 2.1. The AQO listed in Table 2.1 are only applicable at locations where a member of the public could be reasonably expected to spend the relevant averaging period. Further examples of this are presented in Table 2.2.

[10] National Planning Practice Guidance web-based resource. Accessible at: http://planningguidance.planningportal.gov.uk/
[11] Paragraph: 023 Reference ID: 27-023-20140306, revision date 06/03/2014

Table 2.1: AQOs relevant to the site

Pollutant	Averaging Period	AQO (µg/m³)	Exceedance Allowance	Percentile Equivalent
Particulate Matter (as PM_{10})	Annual	40	-	-
	24-hour	50	35 per annum	90.4th
Particulate Matter (as $PM_{2.5}$)[(a)]	Annual	20[(b)]	-	-

Notes: [(a)] This is a target value set for a 15% reduction in concentrations at urban background aimed to achieve between 2010 and 2020

[(b)] The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020 amended the annual average Air Quality Objective (AQO) for PM2.5 from 25 µg/m3 to 20 µg/m3 outlined within the Air Quality Standards Regulations (2010 & 2016 Amendments).

Source: Department for Environment Food and Rural Affairs (2016): 'Local Air Quality Management Technical Guidance' (TG.16).

Table 2.2: Examples of where the AQO should apply

Averaging period	Objectives should apply at	Objectives should not apply at
Annual	All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes etc.	Building façades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short-term.
24 Hour	All locations where the annual mean objective would apply, together with hotels and gardens of residential properties[(a)].	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short-term.
1 Hour	All locations where the annual mean and 24 and 8-hour mean objectives apply. Kerbside sites (for example, pavements of busy shopping streets). Those parts of car parks, bus stations and railway stations etc. which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more.	Kerbside sites where the public would not be expected to have regular access.

Averaging period	Objectives should apply at	Objectives should not apply at
	Any outdoor locations where members of the public might reasonably have expected to spend one hour or longer.	

Note:

(a) "*Such locations should represent parts of the garden where relevant public exposure to pollutants is likely, for example where there is seating or play areas. It is unlikely that relevant public exposure to pollutants would occur at the extremities of the garden boundary, or in front gardens, although local judgement should always be applied.*"

Source:

Department for Environment Food and Rural Affairs (2016): 'Local Air Quality Management Technical Guidance' (TG.16).

As an overall perspective, the NPPF PPG sets out a Site Assessment Flow Chart (reproduced at Figure 2.1) to determine the potential impact of a site in relation to the AQO.

Consequently, where residential properties or other sensitive land uses are within 1 km of the actual source of emission (e.g. mineral processing) the potential for PM_{10} and $PM_{2.5}$ emissions to cause a breach of AQO should be assessed.

Where PM_{10} emissions from site activities are unlikely to cause a breach of AQO, the site should apply good practice measures in dust management to avoid causing dust annoyance, such as set out in PGN 3/08(12)[12].

Under the AQR, and through Local Air Quality Management (LAQM), local authorities are required to review the existing and projected airborne concentrations of relevant pollutants and compare them with the AQO. If an exceedance of any AQO appears likely, an Air Quality Management Area (AQMA) is to be designated with the aim of achieving the objective by the due date.

The local authority responsible for assessing air quality in the area is BMDC.

In their 2020 Air Quality Annual Status Report (ASR)[13], BMDC state that PM_{10} and $PM_{2.5}$ are monitored at three locations in conjunction with NO_2 monitoring within their district; CM2, CM6 and CM8, all within Bradford.

BMDC state that they currently have four AQMAs within the district:

- Mayo Avenue / Manchester Road, for exceedances of the NO_2 annual mean;
- Manningham Lane / Queen's Road, for exceedances of the NO_2 annual and 1-hour mean;
- Thornton Road, declared for exceedances of the NO_2 annual mean; and

[12] Department for Environment, Food & Rural Affairs (2012). *Process Guidance Note 3/08(12): Statutory guidance for quarry processes*
[13] City of Bradford Metropolitan District Council (2020): 2020 Air Quality Annual Status Report (ASR)

- Shipley Airedale Road, declared for exceedances of the NO_2 annual and 1-hour mean.

The nearest of these (Mayo Avenue) is approximately 17 km from the site so will not be affected by the proposed development.

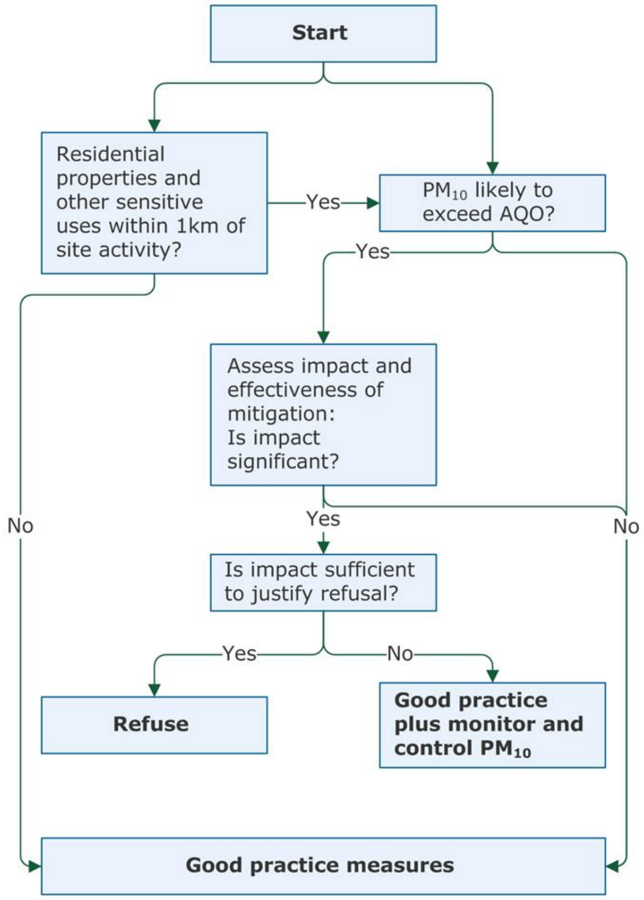

Figure 2.1: Site assessment flow chart (from Planning Practice Guidance)

2.3 Non-statutory guidance

There is no standard method for carrying out a dust assessment for minerals sites although the IAQM (2016) and others provide guidance, as noted above.

This assessment has been carried out with reference to the minerals guidance from IAQM, which states:

> *"The assessment approach described here requires a degree of professional judgement from a competent and suitably experienced air quality professional in order to reach a conclusion on the overall significance of the effect… This guidance is based on the judgement of the IAQM Minerals Guidance Working Group. The IAQM does not expect practitioners to follow the suggested approach in all circumstances."*

2.3.1 Local

2.3.2 BMDC Local Plan

The BMDC Emerging Local Plan for 2020 - 2038[14], is a draft of the principal planning policy document for the District, setting out the policies and proposals to support the development of the district through to 2038. The Local Plan contains two strategic policies that relate to air quality.

Policy SP1: Delivering Sustainable Development states that:

> *"4. It will support the social aspects of sustainability by ensuring that sufficient land is allocated to meet the housing needs of the district's growing population, by promoting high quality design, by developing healthy places with access to a network of green spaces which enhance the built environment, provide opportunities for sport and recreation and by taking action to tackle air quality problems.*
>
> *5. In order to maximise the benefits of new development and reduce and mitigate the any adverse effects the Council will undertake an approach to site selection and allocation which:*
>
> *…*
>
> *e) Ensures that wherever possible development enables the enhancement of the built and natural environment and minimises the adverse environmental impacts of growth, in particular with regards to climate change, air quality, biodiversity and habitats.".*

Policy SP9: Climate Change, Environmental Sustainability and Resource Use states that:

> *"Development proposals should mitigate their potential impacts on climate change by:*
>
> *…*
>
> *2. Improving access to sustainable transport options including walking, cycling and public transport routes, thereby reducing emissions from road transport and helping to improve air quality"*

Policy SP12: Strategic Planning for Minerals also states that in mineral planning, the Council will:

> *"4. Seek to strike the necessary balance between the need for new minerals development and the protection of the District's human and natural resources by offering policy support for sustainable minerals development, which meets key environmental criteria (see Policy EN15)."*

2.3.2 Air Quality Action Plan

The BMDC Air Quality Action Plan (AQAP) was published in 2009. It contains eight broad actions to improve air quality. For further details, refer to the AQAP.

[14] City of Bradford Metropolitan District Council (2017) 'Update on the Local Plan – Regulation 18 Consultation 2021'

3 Methodology

This section of the report sets out the methodology followed for the dust and air quality assessments, which consider potential impacts arising from the key pollutants and 'residual source emissions' (i.e. dust emissions after mitigation) in relation to the operational and restoration stages of the development.

3.1 Scope of the assessment

The dust assessment considers impacts to air from the following key pollutants, and whether they are scoped into or out of the assessment:

- NO_2 and NO_x, (associated with road traffic);
- PM_{10} and $PM_{2.5}$ (associated both with road traffic and with quarry operations); and
- Disamenity dust (associated with quarry operations).

3.2 Nitrogen dioxide (NO_2)

NO_2 and NO_x are largely associated with exhaust emissions, especially Heavy Duty Vehicle (HDV) traffic, and current guidance suggests that a detailed air quality assessment is required if any indicative criteria are met (presented in Table 3.1, from guidance produced by EPUK and IAQM[15]). Any change in traffic movements of 100 HDV movements per day (or 25 within or adjacent to an AQMA) as an AADT (Annual Average of Daily Traffic) can therefore be an indicative trigger level for when the operational traffic of a development could have a significant effect on air quality. In effect, NO_2 could be scoped out of the EIA if vehicle movements were below the indicative threshold.

It is anticipated that the proposed development will generate up to 10 two-way HDV movements per weekday (as a worst-case scenario). Consequently, the number of daily vehicular movements associated with the operational phase of the proposed scheme is well below the indicative criteria listed in Table 3.1, and any impacts from HDV emissions will not be significant.

[15] Institute of Air Quality Management and Environmental Protection UK (2017). Land-Use Planning & Development Control: Planning for Air Quality

Table 3.1: Indicative criteria for requiring an Air Quality Assessment (from EPUK/IAQM, 2017)

The development will:	Indicative Criteria to Proceed to an Air Quality Assessment [a]
1. Cause a significant change in Light Duty Vehicle (LDV) traffic flows on local roads with relevant receptors. (LDV = cars and small vans <3.5t gross vehicle weight).	A change of LDV flows of: - more than 100 AADT within or adjacent to an AQMA - more than 500 AADT elsewhere.
2. Cause a significant change in Heavy Duty Vehicle (HDV) flows on local roads with relevant receptors. (HDV = goods vehicles + buses >3.5t gross vehicle weight).	A change of HDV flows of: - more than 25 AADT within or adjacent to an AQMA - more than 100 AADT elsewhere.
3. Realign roads, i.e. changing the proximity of receptors to traffic lanes.	Where the change is 5m or more and the road is within an AQMA.
4. Introduce a new junction or remove an existing junction near to relevant receptors.	Applies to junctions that cause traffic to significantly change vehicle accelerate/decelerate, e.g. traffic lights, or roundabouts.
5. Introduce or change a bus station.	Where bus flows will change by: - more than 25 AADT within or adjacent to an AQMA - more than 100 AADT elsewhere.
6. Have an underground car park with extraction system.	The ventilation extract for the car park will be within 20 m of a relevant receptor. Coupled with the car park having more than 100 movements per day (total in and out).
7. Have one or more substantial combustion processes, where there is a risk of impacts at relevant receptors. NB. this includes combustion plant associated with standby emergency generators (typically associated with centralised energy centres) and shipping.	Typically, any combustion plant where the single or combined NO_x emission rate is less than 5 mg/sec[a] is unlikely to give rise to impacts, provided that the emissions are released from a vent or stack in a location and at a height that provides adequate dispersion. In situations where the emissions are released close to buildings with relevant receptors, or where the dispersion of the plume may be adversely affected by the size and/or height of adjacent buildings (including situations where the stack height is lower than the receptor) then consideration will need to be given to potential impacts at much lower emission rates. Conversely, where existing nitrogen dioxide concentrations are low, and where the dispersion conditions are favourable, a much higher emission rate may be acceptable.

[a] As a guide, the 5 mg/s criterion equates to a 450 kW ultra low NO_x gas boiler **or** a 30kW CHP unit operating at <95mg/Nm³. Users of this guidance should quantify the NO_x mass emission rate from the proposed plant, based on manufacturers' specifications and operational conditions.

3.3 Fine particulate matter (PM_{10} and $PM_{2.5}$)

BMDC are responsible for air quality within the jurisdiction in which the proposed development is located. BMDC state in their 2020 Air Quality Annual Status Report (ASR)[16] that PM_{10} and $PM_{2.5}$ are monitored at three locations within their district; all within Bradford. These sites have been designated as 'urban center and 'roadside', and are not deemed to be representative of the proposed development site.

Particulate matter can also arise from a wide range of sources other than traffic at minerals sites thus the potential impacts of PM_{10} and $PM_{2.5}$ arising from the proposed development require further consideration.

[16] Bureau Veritas (2021): Warwick District Council Annual Status Report 2021

With regard to PM_{10} and $PM_{2.5}$ impacts associated with the proposed development, one approach is that the potential impacts on AQO can be determined by comparing the total predicted environmental concentration (PEC) of particulate matter estimated to arise from them with the annual mean objective. The PEC can be determined by combining the existing background ambient concentration (AC) and the expected process contribution (PC).

The AC for PM_{10} and $PM_{2.5}$ can be determined from publicly available data. For this assessment, the Defra national annual estimated average background concentrations, which are determined for every local authority in the UK at 1 × 1 km grid square resolution[17], have been used.

The IAQM minerals guidance (2016) states at Section 5.2:

> *"If the long term background PM_{10} concentration is less than 17 μg/m^3 there is little risk that the Process Contribution (PC) would lead to an exceedance of the annual-mean objective and such a finding can be put forward qualitatively, without the need for further consideration, in most cases."*

The PC for the operation, the consequent PEC and resultant impacts on the AQO for PM_{10} and $PM_{2.5}$ arising from the operation are considered further below.

3.4 Disamenity dust

3.4.1 Dust definitions, generation and propagation

'Dust' is generally regarded as particulate matter up to 75 μm (microns) diameter and can be considered in two categories. Fine dust, essentially particles up to 10 μm, is commonly referred to as PM_{10} and, as set out above, PM_{10} is measured to agreed standards and forms part of the AQO.

Coarser dust (essentially particles greater than 10 μm) is generally regarded as 'disamenity dust' and can be associated with annoyance, although there are no official standards (such as AQO) for dust annoyance[18].

Although it is a widespread environmental phenomenon, dust is also generated through many human activities. These include processes on minerals sites and surface mines, as well as those associated with heavy industry, waste management, construction and demolition, agriculture (especially arable farming) and road transport.

Dust is generally produced by mechanical action on materials and is carried by moving air when there is sufficient energy in the airstream. More energy is required for dust to become airborne than for it to remain suspended. Dust is removed through gravitational settling (sedimentation), washout (for example during rainfall or by wetting) and by impaction on

[17] Department for Environment, Food & Rural Affairs (2018). *Background Mapping data for local authorities – 2018*. Available at https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018

[18] The expression 'disamenity dust' has been recently promoted as a suitable expression for 'nuisance' dust, *i.e.* generally visible particulate matter' rather than specifically and in a legal sense to statutory nuisance, as defined in Section 79 of the Environmental Protection Act 1990

surfaces (e.g. on vegetative screening). Dust can be re-suspended where conditions allow, such as from bare ground.

Dust emissions from a minerals site, its propagation and potential impacts can be considered in terms of 'source-pathway-receptor' relationships. Dust can arise from a variety of processes and locations within a site and can be difficult to quantify.

PGN 3/08 (12) states that dust emissions can arise from a range of processes at minerals sites. The AEA Good Practice Guide[19] sets out a table of dust source types and characteristics for minerals sites (reproduced at Appendix A).

In addition, the IAQM minerals guidance (2016) sets out suggested site processes that may be considered distinctly as having the potential to generate dust at a minerals site. This is outlined at Appendices 3 and 4 of the guidance (reproduced in part within the text below). From this, the residual source emissions for different activities may be determined. A guide to the estimation of residual source emissions, reliant on the professional judgement of the assessor, is provided at Appendix 4 of the IAQM minerals guidance (2016) and is reproduced in Appendix B.

Consequently, however it is recognised that there is a potential for dust emissions to occur at various stages of the operation, but it is also known that these can generally be controlled by recognised practices, as set out below.

The most common pathway for dust propagation is by air. Dust propagation depends on particle size, wind energy and disturbance activities. Large dust particles generally travel shorter distances than small particles. It is often considered that particles greater than 30 µm will largely deposit within 100 m of sources, those between 10 – 30 µm will travel up to 250 – 500 m and particles less than 10 µm will travel up to 1 km from sources, however there is a notable reduction in concentration with distance.

For a stone quarry, experience indicates that nuisance effects of dust arising from such quarries may extend up to a maximum of 400 m from the source although, as noted in various guidance documents, residents' concerns are most likely to be experienced within 100 m of the dust source, or sources. The IAQM minerals guidance (2016) states that dust impacts will mainly occur within 250 m of the operation for sand and gravel quarries, and within 400 m of the operation for hard rock (e.g. stone) quarries.

Consequently, to ensure that the potential impact of the development is fully determined, all receptors within 400 m of the proposed development have been scoped into the assessment.

3.5 Dust sources, potential for emissions and Residual Source Emissions (with mitigation in place)

[19] AEA (2010). *Good Practice Guide: Control and Measurement of Nuisance Dust and PM_{10} from the Extractive Industries*

Residual Source Emissions (RSE) are defined in the 2016 IAQM guidance as the potential dust emissions from a site activity after designed-in mitigation measures have been taken into account.

The scale and nature of proposed works determines the level of RSE. Judgement of the categorisation of RSE (generally Small, Medium and Large) takes into account the emission potential for each on-site source (including source strength, frequency and duration) and how effectively they are likely to be controlled by designed-in mitigation measures.

Specific factors include:

- The activities being undertaken;
- The types and properties of materials involved;
- The size of the site;
- The duration and frequency of activities;
- The likely effectiveness of the designed-in mitigation measures;
- Other mitigation measures applied to reduce or eliminate dust; and
- The meteorological conditions that can promote or inhibit dust generation.

Potential sources or site activities that may give rise to dust as a result of onsite operations are:

- Site preparation and restoration
- Mineral extraction;
- Materials handling and on-site transportation;
- Wind scouring of exposed surfaces and stockpiles; and
- Off-site transportation

The potential dust sources are considered below, setting out both the potential for emissions and suggested mitigation methods in Section 6.

From these, the determined Residual Source Emissions (i.e. the potential dust emissions after designed-in mitigation measures have been taken into account) are stated per activity.

Note that for certain processes (e.g. soil and overburden handling) consideration is by necessity generic, in that they apply to that process wherever it takes place within the quarry but at different locations according to phasing.

The Residual Source Emissions outlined below take into account the recommended mitigation measures provided in Section 6 further below.

3.5.1 Site preparation and restoration

There is potential for high levels of airborne and wind-blown dust propagation from the preparation and restoration of a minerals site, however these are generally short-term, transient operations. There is also potential for moderate levels of dust emission during overburden, storage and replacement, although it can usually be worked at higher moisture contents than soils, thus reducing the risk of unacceptable dust emissions from this aspect of site operations.

Site preparation may also necessitate crushing and screening of previous mineral waste. Regular maintenance and repair of any associated plant and additional control measures such as water suppression should be used if there is a risk of visible dust from the associated plant being blown over the site boundary towards off-site receptors.

However, given the overall extraction area (less than 4 hectares split over 6 phases), and taking into account the methods applied, with reference to the guidance reproduced in Appendix B, the Residual Source Emissions from site preparation and restoration after mitigation is applied are considered to be Small.

3.5.2 Mineral extraction

Stone would be extracted on a phase-by-phase basis using a 360° excavator. Given the nature of the extracted stone and the desired end product, no blasting is necessary.

Consequently, there is a low risk of airborne dust propagation emissions from mineral extraction due to the method and rate of extraction, and the nature of materials being extracted. With reference to the guidance reproduced in Appendix B, the Residual Source Emissions from mineral extraction after mitigation is considered to be Small.

3.5.3 Materials handling and on-site transportation

There is a high risk of dust propagation from transport on unpaved roads unless appropriate mitigation measures are applied. Dust may be generated from downward-blowing exhausts and cooling fans as well as air turbulence caused by the movement of vehicles so these should be avoided where possible.

Stone will be transported from extraction areas via front end loaders and exported off-site for further processing. The internal haul route layout should be designed to reduce distances where possible, ensuring that the majority of on-site vehicle movements take place away from the site boundaries.

A speed limit of 15 mph should be set for internal site haul routes, minimising the potential for dust propagation as a result of vehicle movements.

Internal haul routes will be wetted down with a tractor and bowser where necessary.

Given that all materials will primarily be handled within the quarry void and exported directly off-site, with reference to the guidance reproduced in Appendix B, the Residual Source Emissions from on-site transportation after mitigation is applied are considered to be Small.

3.5.4 Wind scouring of exposed surfaces and stockpiles

As a general rule, there is a moderate risk of wind-blown dust propagation from dry surface layers of stripped surfaces, freshly constructed bunds prior to seeding and from bare ground. However, the bund to the west of the site is already vegetated.

Stockpiles of material not exported from site (e.g. poor quality stone) should be kept away from receptors and dampened if required during dry, windy conditions.

Given the small size of the site and the material extracted, and with reference to the guidance reproduced in Appendix B, the Residual Source Emissions from wind-whip from bare ground and exposed surfaces after mitigation is applied are considered to be Small.

3.5.5 Off-site transportation

As outlined earlier, the proposed development will generate up to 10 two-way HDV movements per weekday (as a worst-case scenario). HDVs will enter and exit the site via the haul route to the south of the site. The access road should be wetted down during dry and windy weather, and vehicles exiting the site should be checked to remove any material accumulated on their undersides.

With these points in mind, and with reference to the guidance reproduced in Appendix B, the Residual Source Emissions from off-site transportation after mitigation is applied are considered to be Small.

3.5.6 Summary of Residual Source Emissions (with mitigation)

The estimated Residual Source Emissions for the primary aspects of the proposed development are summarised in Table 3.2.

Table 3.2: Summary of Residual Source Emissions, proposed development

Activity	Residual Source Emission
Site preparation and restoration	Small
Mineral extraction	Small
Materials handling and on-site transportation	Small
Wind scouring of exposed surfaces and stockpiles	Small
Off-site transportation	Small

3.6 Meteorological data

Meteorological conditions can have a significant effect on the potential for dust propagation from a minerals site. Of particular importance are wind speed, wind direction and precipitation.

Dust can be carried from a source towards receptors (such as nearby homes, other businesses and designated ecological sites) according to the strength and direction of wind. Precipitation is recognised to suppress dust and 0.2 mm of antecedent rainfall is considered sufficient to suppress windblown dust for a number of hours.

A wind rose showing the 'dry' hours[20] in 2015 - 2019 for Leeds Bradford Airport, approximately 18 km to the southeast of the site, is presented at Figure 3.1. This

[20] 'Dry' hours are those with less than 0.2 mm liquid equivalent precipitation and are associated with an increased risk of dust propagation

demonstrates that westerly winds are most prevalent in this area, although winds from the southwest are also relatively frequent.

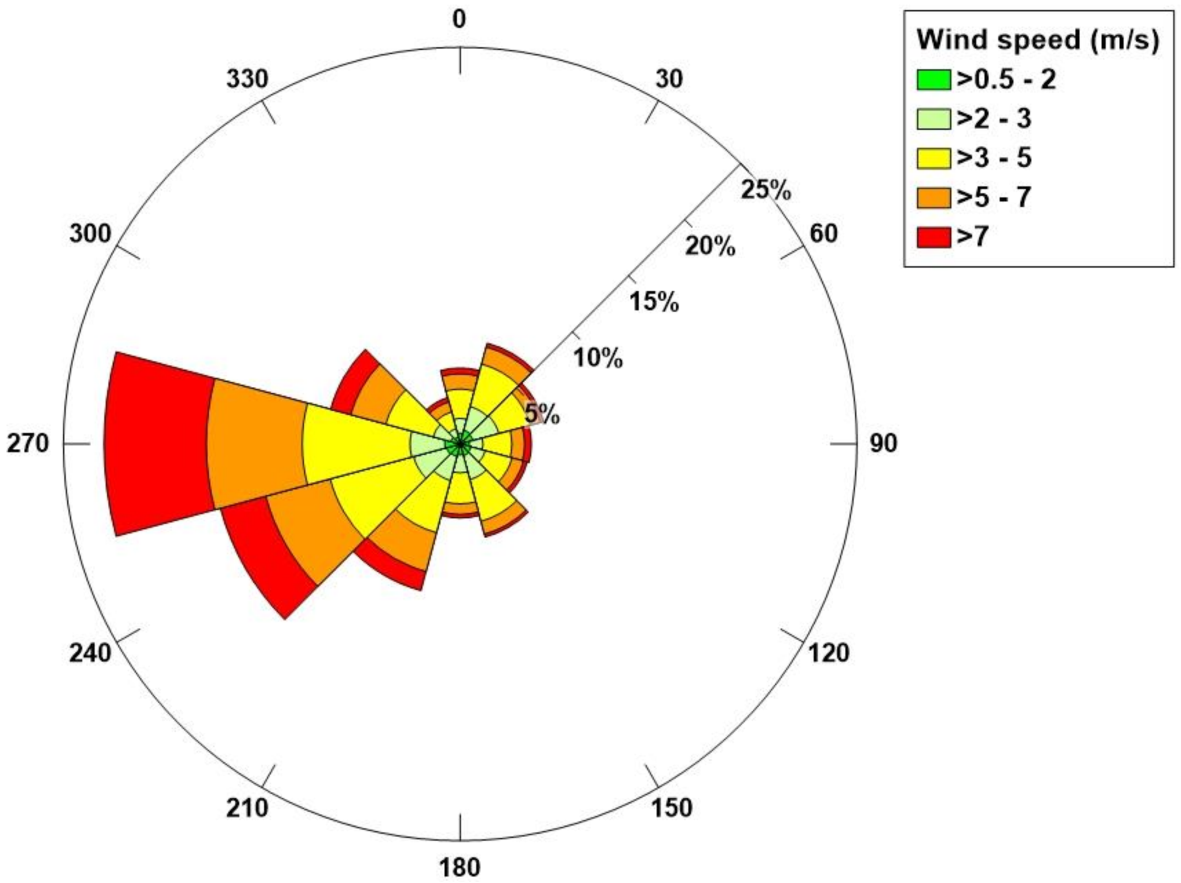

Figure 3.1: Wind rose, dry hours (five year average), Leeds Bradford, 2015-2019

3.7 Receptors

Dust receptors can be within or beyond the quarry boundary. Whilst dust generation within a minerals site is primarily of concern to its operator, staff and visitors, dust can propagate beyond the site boundary to affect people and properties beyond, unless adequate control measures are in place. It is important to recognise that there may be other dust sources in the vicinity of a quarry (such as road traffic or arable farmland).

Table 3.3 provides a summary of receptors situated within 400 m of the proposed development boundary, along with the closest distance to dust-generating activities, and their deemed sensitivity to dust soiling (as set out below). As outlined in Section 3.4.1, the IAQM minerals guidance (2016) states that dust impacts will mainly occur within 250 m of the operation for sand and gravel quarries, and within 400 m of the operation for hard rock (e.g. stone) quarries. All receptors within 400 m have therefore been scoped into the assessment.

The locations of the receptors are shown in Figure 3.2, along with distance buffers from the proposed extraction area.

The IAQM minerals guidance (2016) sets out guidance regarding the sensitivity of human receptors to dust; for this assessment all residential properties are considered to have a High sensitivity.

With regard to ecological receptors the IAQM minerals guidance (2016) stresses that professional judgement is required to identify the specific sensitivity of a given ecological receptor, but notes that sensitivity to dust for ecological receptors may relate to international, national or local designations. There are no statutory designated ecological receptors within 400 m of the proposed development.

The IAQM minerals guidance (2016) suggests that potential dust impacts arising from a minerals site may be considered in relation to the identified dust source activities and locations. From above, consideration is made of potential impacts to the receptors identified in Table 3.3 with regard to principal dust sources.

The distances shown are the minimum between any potential receptor and any given stage of site operations and thus can be considered to represent a 'worst-case' evaluation. For all receptors, the activity in closest proximity will be the mineral extraction area or the haul route leaving the site. Similarly, the directions to dust sources consider the maximum potential arc of direction (taking into account activities on all phases within 400 m), so are also considered to represent a 'worst-case' evaluation.

Table 3.3: Receptors considered in the assessment

No.	Sensitivity	Primary direction/s to dust sources (°)	Minimum distance to dust source (m)
R1	High	105 - 165	255
R2	High	255 - 285	395
R3	High	285 - 015	175
R4	High	045 - 105	140
R5	High	015 - 105	210
R6	High	045 - 105	230
R7	High	045 - 105	225
R8	High	045 - 105	315
R9	High	045 - 105	305

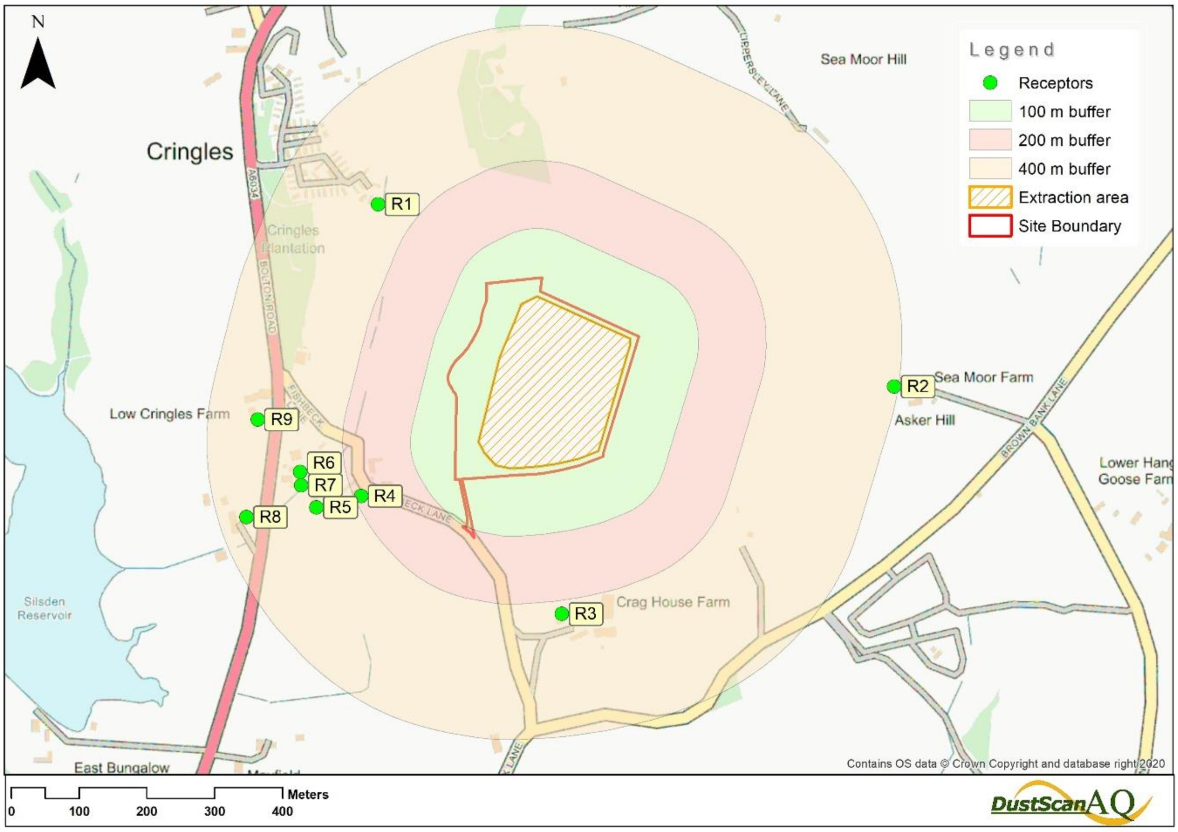

Figure 3.2: Locations of receptors with respect the proposed development

3.8 Assessment criteria

The assessment has been carried out with reference to relevant guidance, in particular the PPG minerals guidance (2014) and the IAQM minerals guidance (2016). Key tables and figures from that guidance are reproduced below.

From above, it is recognised that dust impacts reduce with distance. IAQM suggest that minerals dust assessments are carried out in relation to three distance criteria, as reproduced in Table 3.4. These criteria have been applied to this assessment.

Table 3.4: Categorisation of receptor distance from source (reproduced from IAQM, 2016)

Category	Criteria
Distant	Receptor is between 200 and 400 m from the dust source
Intermediate	Receptor is between 100 and 200 m from the dust source
Close	Receptor is less than 100 m from the dust source

In addition to the above, wind speed is recognised to affect dust propagation. The IAQM minerals guidance (2016) suggests a range of wind speed criteria, as reproduced in Table 3.5. These wind speed criteria have been applied to this assessment.

Table 3.5: Categorisation of frequency of potentially dusty winds (reproduced from IAQM, 2016)

Frequency Category	Criteria
Infrequent	Frequency of winds (>5 m/s) from the direction of the dust source on dry days are less than 5%
Moderately frequent	The frequency of winds (>5 m/s) from the direction of the dust source on dry days are between 5% and 12%
Frequent	The frequency of winds (>5 m/s) from the direction of the dust source on dry days are between 12% and 20%
Very frequent	The frequency of winds (>5 m/s) from the direction of the dust source on dry days are greater than 20%

From this, the IAQM (2016) suggest that the effectiveness of the pathway for dust propagation may be evaluated by combining the distance/s to receptors and the frequencies of potentially dusty winds (as set out in Table 3.6). This method has been applied to this assessment.

Table 3.6: Pathway effectiveness (reproduced from IAQM, 2016)

		Frequency of potentially dusty winds			
		Infrequent	**Moderately frequent**	**Frequent**	**Very frequent**
Receptor Distance Category	**Close**	Ineffective	Moderately Effective	Highly Effective	Highly Effective
	Intermediate	Ineffective	Moderately Effective	Moderately Effective	Highly Effective
	Distant	Ineffective	Ineffective	Moderately Effective	Moderately Effective

The IAQM minerals guidance (2016) suggest that the 'risk of dust impact' may be assessed by considering the pathway effectiveness (from Table 3.6) with the Residual Source Emissions (from Table 3.2), using Table 3.7. This approach has been followed for this assessment.

Table 3.7: Estimation of dust impact risk (reproduced from IAQM, 2016)

		Residual Source Emissions		
		Small	**Medium**	**Large**
Pathway Effectiveness	**Highly effective pathway**	Low Risk	Medium Risk	High Risk
	Moderately effective pathway	Negligible Risk	Low Risk	Medium Risk
	Ineffective pathway	Negligible Risk	Negligible Risk	Low Risk

As stated by the IAQM minerals guidance (2016) estimation of residual source emissions is a matter of professional judgement based on knowledge of the site and its locality, the processes involved and how these might relate to corresponding activities at other minerals sites.

Consequently, it should be recognised that these are wide ranging and therefore not prescriptive criteria and, as with all other aspects of dust assessment for minerals sites, rely on professional judgement based on the experience of the assessor.

From this, the magnitude of dust impacts may be evaluated by combining the dust impact risk with the receptor sensitivity (noted above), as shown in Table 3.8. This approach has been followed for this assessment.

Table 3.8: Descriptors for magnitude of dust effects (reproduced from IAQM, 2016)

		Receptor Sensitivity		
		Low	**Medium**	**High**
Dust Impact Risk	**High Risk**	Slight Adverse Effect	Moderate Adverse Effect	Substantial Adverse Effect
	Medium Risk	Negligible Effect	Slight Adverse Effect	Moderate Adverse Effect
	Low Risk	Negligible Effect	Negligible Effect	Slight Adverse Effect
	Negligible Risk	Negligible Effect	Negligible Effect	Negligible Effect

Consequently, from the IAQM minerals guidance (2016) an assessment of the potential severity of dust impacts associated with the operation may be determined.

3.9 Dust assessment uncertainties, limitations and assumptions

As set out above, there is no standard method for carrying out a minerals dust assessment and the most recent guidance (IAQM, 2016) recognises the need for professional judgement in carrying out such an assessment. Consequently, an uncertainty associated with any minerals dust assessment is that the assessor's judgement is appropriate. The lead author of this assessment was suitably experienced to carry out the assessment, and the assessment and calculations went through a rigorous internal review and approval protocol prior to issuing to the client.

A limitation of any assessment is that it is carried out without the development in place, i.e. as a future scenario. Consequently, it is not possible to make any quantification of the potential impacts although every effort has been made to accurately assess any potential impact of the proposed development.

A limitation of this assessment is that it has been carried out with reference to weather data from beyond the site boundary. This is in accordance with the IAQM minerals guidance (2016).

It is assumed that the site will be developed and operated as described for the purposes of this assessment.

It is assumed that there is no change in the relevant AQO, or that any AQO or similar national or local objective, threshold or limit value will be introduced for disamenity dust.

It is assumed that the mitigation set out in this report will be adopted once planning consent has been granted, and that the mitigation measures will be applied as recommended, and consequently that the residual source emission values determined in this assessment will be realistic estimates of dust emissions associated with the operations described.

4 Baseline conditions

4.1 Local authority monitoring data

As mentioned previously, BMDC undertake PM_{10} and $PM_{2.5}$ monitoring at three locations within the district, however these are classed as ‘urban centre’ and ‘roadside’ site types, and are located in Bradford, more than 17 km from the proposed development. Consequently, the monitored data are not suitable for determining likely baseline concentrations at the proposed development site.

4.2 Defra modelled background data

Modelled background concentrations have been obtained from Defra, who provide background pollution concentration estimates to assist local authorities in undertaking their ‘Review and Assessment’ work. This data is available to download from the Defra air quality resource website for NO_x, NO_2, PM_{10} and $PM_{2.5}$ for every 1 km x 1 km grid square for all local authorities. The current dataset is based on 2018 background data and future year projections are available for 2018 to 2030.

The estimated PM_{10} and $PM_{2.5}$ concentrations for 2018 (the Defra baseline year) and 2022 for the grid squares encompassing the proposed development are set out in Table 4.1 and Table 4.2.

Table 4.1: Defra estimated background ambient PM_{10} concentrations for the grid squares in which the operation is located

Grid reference		PM_{10} concentration (µg/m^3)	
Eastings	**Northings**	**2018**	**2022**
405500	448500	8.8	8.3
405500	447500	9.1	8.5
Average		**9.0**	**8.4**

Table 4.1 shows that the 2022 predicted PM_{10} background concentration in the vicinity of the site is just 8.3 µg/m^3, equivalent to 20.8 % of the PM_{10} annual mean objective (40 µg/m^3).

As such, based on the IAQM minerals guidance (2016), given that the predicted background concentration is well below 17 µg/m^3, there is little risk that on site operations would lead to an exceedance of the annual mean objective for PM_{10}.

Table 4.2: Defra estimated background ambient $PM_{2.5}$ concentrations for the grid squares in which the operation development is located

Grid reference		$PM_{2.5}$ concentration (µg/m^3)	
Eastings	**Northings**	**2018**	**2022**
405500	448500	6.1	5.7
405500	447500	6.2	5.8
Average		**6.2**	**5.8**

Table 4.2 shows that the 2022 predicted $PM_{2.5}$ background concentration in the vicinity of the site is 5.8 µg/m^3, equivalent to 29 % of the annual mean AQO (20 µg/m^3. Consequently, the potential impacts of operations on the target value for $PM_{2.5}$ are not considered to be significant.

5 Potential impacts

5.1 Potential disamenity dust impacts

This section sets out the potential impacts of the operation, which have been determined by means of the method outlined by the IAQM (2016).

All on-site activities associated with the operation have been assessed to have a Small residual source emission after mitigation. The potential impacts as a result of each specific site activity with each specific residual source emission are presented below in Table 5.1 to Table 5.5.

Table 5.1: Outcome of dust assessment for receptors potentially affected by site preparation and restoration as a result of the proposed development.

No.	Dust source location	Pathway effectiveness	Dust impact risk	Magnitude of dust effects
R1	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R2	Extraction area	Moderately Effective	Negligible Risk	Negligible Effect
R3	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R4	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R5	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R6	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R7	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R8	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R9	Extraction area	Ineffective	Negligible Risk	Negligible Effect

Table 5.2: Outcome of dust assessment for receptors potentially affected by mineral extraction as a result of the proposed development.

No.	Dust source location	Pathway effectiveness	Dust impact risk	Magnitude of dust effects
R1	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R2	Extraction area	Moderately Effective	Negligible Risk	Negligible Effect
R3	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R4	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R5	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R6	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R7	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R8	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R9	Extraction area	Ineffective	Negligible Risk	Negligible Effect

Table 5.3: Outcome of dust assessment for receptors potentially affected by materials handling and on-site transportation as a result of the proposed development.

No.	Dust source location	Pathway effectiveness	Dust impact risk	Magnitude of dust effects
R1	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R2	Extraction area	Moderately Effective	Negligible Risk	Negligible Effect
R3	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R4	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R5	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R6	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R7	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R8	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R9	Extraction area	Ineffective	Negligible Risk	Negligible Effect

Table 5.4: Outcome of dust assessment for receptors potentially affected by wind scouring of exposed surfaces and stockpiles as a result of the proposed development.

No.	Dust source location	Pathway effectiveness	Dust impact risk	Magnitude of dust effects
R1	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R2	Extraction area	Moderately Effective	Negligible Risk	Negligible Effect
R3	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R4	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R5	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R6	Extraction area	Ineffective	Negligible Risk	Negligible Effect

No.	Dust source location	Pathway effectiveness	Dust impact risk	Magnitude of dust effects
R7	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R8	Extraction area	Ineffective	Negligible Risk	Negligible Effect
R9	Extraction area	Ineffective	Negligible Risk	Negligible Effect

Table 5.5: Outcome of dust assessment for receptors potentially affected by off-site transportation as a result of the proposed development.

No.	Dust source location	Pathway effectiveness	Dust impact risk	Magnitude of dust effects
R3	Access route	Moderately Effective	Negligible Risk	Negligible Effect
R4	Access route	Ineffective	Negligible Risk	Negligible Effect
R5	Access route	Ineffective	Negligible Risk	Negligible Effect
R6	Access route	Ineffective	Negligible Risk	Negligible Effect
R7	Access route	Ineffective	Negligible Risk	Negligible Effect
R8	Access route	Ineffective	Negligible Risk	Negligible Effect

The results of the assessment show that all nearby receptors are likely to experience Negligible effects as a result of the proposed development.

This assessment assumes that standard mitigation measures are in place. With reference to the IAQM minerals guidance (2016) the overall impact of the operation is therefore considered to be not significant.

5.2 Potential impacts to human health

As discussed in Section 4, the predicted annual background PM_{10} concentrations are well below 17 $\mu g/m^3$, so there is little risk that the process contribution would lead to an exceedance of the relevant objectives.

Additionally, the predicted annual background and monitored baseline $PM_{2.5}$ concentration is well within the annual mean objective, so there is little risk of an exceedance.

As the operation is not likely to significantly impact the PM_{10} and $PM_{2.5}$ concentrations locally, the potential impacts to human health are considered to be Negligible.

5.3 Cumulative impacts

There are no other significant existing or planned sources of mineral dust in the vicinity of the site that have the potential to cause cumulative dust impacts.

Other general sources of dust in the area may include local agriculture, but due to the negligible risk from the proposed development and the transient nature of dust from arable farmland, any cumulative impacts are also likely to be negligible.

6 Mitigation measures

The recommended dust mitigation measures are set out below.

6.1 Dust Management Plan (DMP)

As set out above, adverse impacts from the site activities identified in Section 3.5 may be mitigated using a range of measures. Suggested mitigation measures are given below, and are drawn from experience and best practice guidance.

It is recommended that the mitigation measures set out below are expanded upon in a Dust Management Plan for use during operation of the site.

6.2 Site preparation and restoration

Unacceptable dust emissions from soil and overburden stripping, storage and reinstatement can be controlled by minimising working of material in very dry, windy conditions, by reducing drop heights at material transfer points and controlling vehicle speeds. As the site includes an existing vegetated bund to the west, this can be retained to act as existing screening.

Site preparation may also necessitate the crushing and screening of previous mineral waste, which should take place as far from receptors as practically possible. Regular maintenance and repair of any associated plant should be undertaken to ensure correct operation and to minimise dust generation. Additional control measures should be put into place if there is a risk of visible dust from the associated plant being blown over the site boundary towards off-site receptors.

6.3 Mineral extraction

There is a moderate risk of airborne dust propagation emissions from mineral extraction due to the type of minerals present on site, but additional control measures (such as wetting down with a water bowser) should be considered if there is a risk of visible dust from the extraction area being blown over the site boundary towards off-site receptors.

6.4 Materials handling and on-site transportation

To avoid dust generation relating to vehicle movements, mobile plant with upward or sideways exhausts should be used. Site haulage should keep to designated haul routes wherever possible. Unmade access roads should be kept in good repair and wetted as required with a water bowser or sprinkler system. Vehicle speed limits should be kept to a minimum (ideally 15 mph) but would be determined according to the site and weather conditions pertaining at the time.

When handling materials, ensure that drop heights are kept to a minimum.

6.5 Wind scouring of exposed surfaces and stockpiles

The effects of wind-blow across stripped surfaces, unpaved vehicle turning areas, stockpiles, and other areas of bare ground will be minimised by ensuring that loose materials are removed or treated as necessary. A high standard of housekeeping can also help to minimise the effect of wind scouring. Additionally, dust emissions from exposed surfaces such as internal haul routes and stockpiles can be minimised by wetting down with a water bowser as necessary, especially in periods of dry, windy weather.

Extracted mineral may be wetted down to reduce the risk of wind-blow from exposed surfaces.

6.6 Off-site transportation

The effects of off-site transportation can be minimised by ensuring that the site access route is kept clean and in good repair. During dry, windy conditions it should be wetted down with a tractor and bowser. Regular use of a road sweeper on the public highway in proximity to the site entrance should be considered, and provision should be made for its use to clean the highway following an unforeseen trackout event.

All vehicles leaving the site with loose material should be sheeted where appropriate, to prevent dust release. The wheels and undercarriages of vehicles should be inspected before leaving the site and washed as necessary.

7 Conclusion

A. D. Calvert Architectural Stone Supplies Ltd (Calverts) are preparing a planning application for the re-opening of a stone quarry at Horn Crag, near Silsden, Bradford. The proposed development involves the extraction of approximately 520,000 tonnes of high-quality masonry stone over a 20 year period, with subsequent restoration to a mixture of habitats and vegetation.

This assessment was carried out by competent professionals and with appropriate reference to relevant policy and guidance.

The assessment considered the potential impacts on the Air Quality Objectives (AQO) for PM_{10} and $PM_{2.5}$, and from 'nuisance' or 'disamenity' dust arising from the proposed development.

Provided that the dust mitigation measures contained within this assessment are fulfilled, the assessment shows there would be Negligible magnitude of dust effects as a result of the proposed development at all nearby receptors. Activities associated with the proposed development are also not likely to have an adverse impact on particulate matter concentrations. Consequently, exceedances of the relevant AQOs are not likely.

Consequently, this assessment shows that the proposed development can be operated in a manner unlikely to cause significantly adverse dust impacts in its vicinity, and with reference to best practice guidance, the overall impact of the proposed development is considered to be not significant.

The proposal is considered not to conflict with any national, regional and local planning policy.

Appendix A: Dust Source Types and Characteristics (AEA Good Practice Guide, 2010)

Activity	Relevance for mineral types	Duration of activity	Potential for dust emission
Soil handling	Most minerals	Relatively short	**Significant** but depends on dryness and silt or clay content of the material and transportation to stockpiles.
Overburden handling	Most minerals, but quantities vary considerably	Varies. Can be intermittent over life of site	**Significant** but depends on nature of overburden, particularly during unloading and haulage.
Drilling and blasting	Usually for hard rocks	Short, but can take place frequently	Without control, drill rigs **can be significant**. However, most drill rigs now use shrouds and any dust generation is very localised. Properly designed and controlled blasts have limited potential for the creation of dust.
Initial loading activities	All mineral types	Ongoing during extraction	**Can be significant** but varies depending on nature of material, whether wet or dry, volumes handled and equipment used.
Crushing and grading	Most minerals, but not always at the place of extraction	Varies, generally ongoing	**Significance varies** depending on type of equipment and exposure to wind. Controlled through the EPR permit at regulated sites.
Storage of minerals within site	Most mineral types	Usually ongoing during extraction	**Significance varies** depending on the volume of material stored, moisture content, exposure to wind, covering of stockpiles.
Transport and load-out within site	All mineral types	Usually ongoing	**Significance varies** depending on type of vehicle. If transported by road then the size of vehicle, speed and nature of roads (surfaced or unmade) are important factors.
Transport off-site (mainly by road)	All mineral types	Usually ongoing	**Not generally significant** (except near site exits due to the re-suspension of road dust) as lorries tend to be covered. Can be mitigated by road sweeping but this can also raise dust.

Appendix B: Guidance on the estimation of Residual Source Emissions (from IAQM, 2016)

A: Site Preparation/Restoration

LARGE	SMALL
Large working area	Small working area
High bunds	Low bunds
High volume of material movement	Low volume of material movement
High no. heavy plant	Low no. heavy plant
Minimal seeding/sealing of bund surface	Bunds seeded/sealed immediately
Material of high dust potential	Material of low dust potential

B: Mineral Extraction

LARGE	SMALL
Large working area	Small working area
High energy extraction methods	Low energy extraction methods
Material of high dust potential	Material of low dust
Potential high extraction rate	Low extraction rate

C: Materials Handling

LARGE	SMALL
High no. heavy plant	Low no. heavy plant
Unconsolidated/bare surface	Hard standing surface
Activities close to site boundary	Activities within quarry void
Material of high dust potential	Material of low dust potential

D: On-Site Transportation

LARGE	SMALL
Use of unconsolidated haul roads	Use of conveyors
Unpaved haul roads	Paved haul roads
Road surface of high dust potential	Road surface of low dust potential
High no. HDV movements	Low no. HDV movements
High total length of haul roads	Low total length of haul roads
Uncontrolled vehicle speed	Controlled (low) vehicle speed

E: Mineral Processing

LARGE	SMALL
Raw material of high dust potential	Raw material of low dust potential
End product of high dust potential	End product of low dust potential
Complex or combination of processes	Single process
High volume material processed	Low volume material processed

F: Stockpiles/Exposed Surfaces

LARGE	SMALL
Long term stockpile	Short term stockpile
Frequent material transfers	Infrequent material transfers
Material of high dust potential	Material of low dust potential
Ground surface unconsolidated/un-kept	Ground surface hardstanding/clean
Stockpiles close to site boundary	Stockpiles well within quarry void
Large areas of exposed surfaces	Small areas of exposed surfaces
High wind speeds/low dust threshold	Low wind speeds/high dust threshold

G: Off-Site Transportation

LARGE	SMALL
High No. HDV Movements	Low No. HDV Movements
Unconsolidated Access Road	Paved Access Road
Limited/No Vehicle Cleaning Facilities	Extensive Vehicle Cleaning Facilities
Small Length of Access Road	Large Length of Access Road