Institute of
Air Quality
Management

Guidance on the Assessment of Mineral Dust Impacts for Planning

May 2016 (v1.1)

www.iaqm.co.uk

Contents

Acknowledgements

The Institute of Air Quality Management (IAQM) aims to be the authoritative voice for air quality by maintaining, enhancing and promoting the highest standards of working practices in the field and for the professional development of those who undertake this work. Membership of IAQM is mainly drawn from practicing air quality professionals working within the fields of air quality science, air quality assessment and air quality management.

This guidance has been produced as a result of the voluntary contribution of the members of a Working Group, for which IAQM is very grateful. This guidance represents the views of the IAQM and not necessarily the individual members of the working group.

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A number of comments have been received from IAQM members on the draft of this guidance. Many were very detailed and all were useful contributions that have helped clarify the guidance.

This document is available for download from the IAQM website (iaqm.co.uk). Please go to IAQM Guidance.

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Document revision

v1.1 (30/09/16) Table A3-2 - The criteria for ‘infrequent’ changed from ‘all days’ to ‘dry days’
Appendix 4 B: Mineral Extraction - 3rd line under the graphic ‘and/or low moisture content’ changed to and/or high moisture content’.
Appendix 4 C: Materials Handling - 3rd line under graphic commas added after ‘<5 plant’ and after ‘site boundary’.

Foreword

The Institute of Air Quality Management (IAQM) is committed to enhancing the understanding and development of the science behind air quality by promoting knowledge and understanding of best working practices. Membership of IAQM is mainly drawn from practising air quality professionals working within the fields of air quality science, air quality assessment and air quality management.

Air quality professionals are frequently required to assess dust impacts from mineral sites, particularly as part of the planning process, and there is currently little government guidance on how a dust assessment should be undertaken. The National Planning Policy Framework (NPPF) replaced previous guidance in 2012 as part of a process to reduce the volume of planning guidance. New national Planning Practice Guidance (nPPG) for minerals was subsequently published online but provides little further detail. Much of the information within the previous guidance was useful and its replacement has created a vacuum.

This IAQM document has been prepared to assist practitioners undertake such dust assessments for mineral sites. It aims to provide advice on robust and consistent good-practice approaches that can be used to assess the operational-phase dust impacts. This guidance is designed for use in the planning process; it is not designed for other purposes such as Environmental Permitting.

This guidance uses a simple distance-based screening process to identify those minerals sites where the dust impacts are unlikely to be significant and therefore require no further assessment.

Where more detailed assessment is required, a basic assessment framework is presented which employs the Source ⤏ Pathway ⤏ Receptor approach to evaluate the risk of dust impacts and effects.

The predicted scale of dust effects may be classified as either 'significant', or not 'significant'. Where effects are predicted to be 'significant', further mitigation is likely to be required before the proposals are considered to be acceptable under planning policy.

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. Full membership of the IAQM – the only professional body specifically for air quality practitioners in the UK - can be evidence of such competence and experience. Membership of some other professional bodies having relevance to the practice of air quality assessment may also provide a degree of reassurance.

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. Other approaches may also be valid provided they are based on sound scientific principles and are appropriate for the application.

In common with other IAQM guidance it is anticipated that this document will be updated based on user experience and as a result of legislative or other requirements. The user should therefore check the IAQM website (www.iaqm.co.uk) to ensure that the latest version is being followed.

1. Introduction & scope

1.1 Introduction

The UK extracts nearly 200 million tonnes of solid mineral each year[1], with the proportions by mass extracted in 2013 as follows:

- 157 million tonnes (80.8%) of construction minerals;
- 24.6 million tonnes (12.7%) of industrial minerals; and
- 12.8 million tonnes (6.6%) of coal.

In 2013, just over a quarter of the mineral extracted, 58 million tonnes, was sand and gravel, with 94.3 million tonnes of 'crushed rock'. In the UK, these minerals are typically extracted from the surface in quarries and mines.

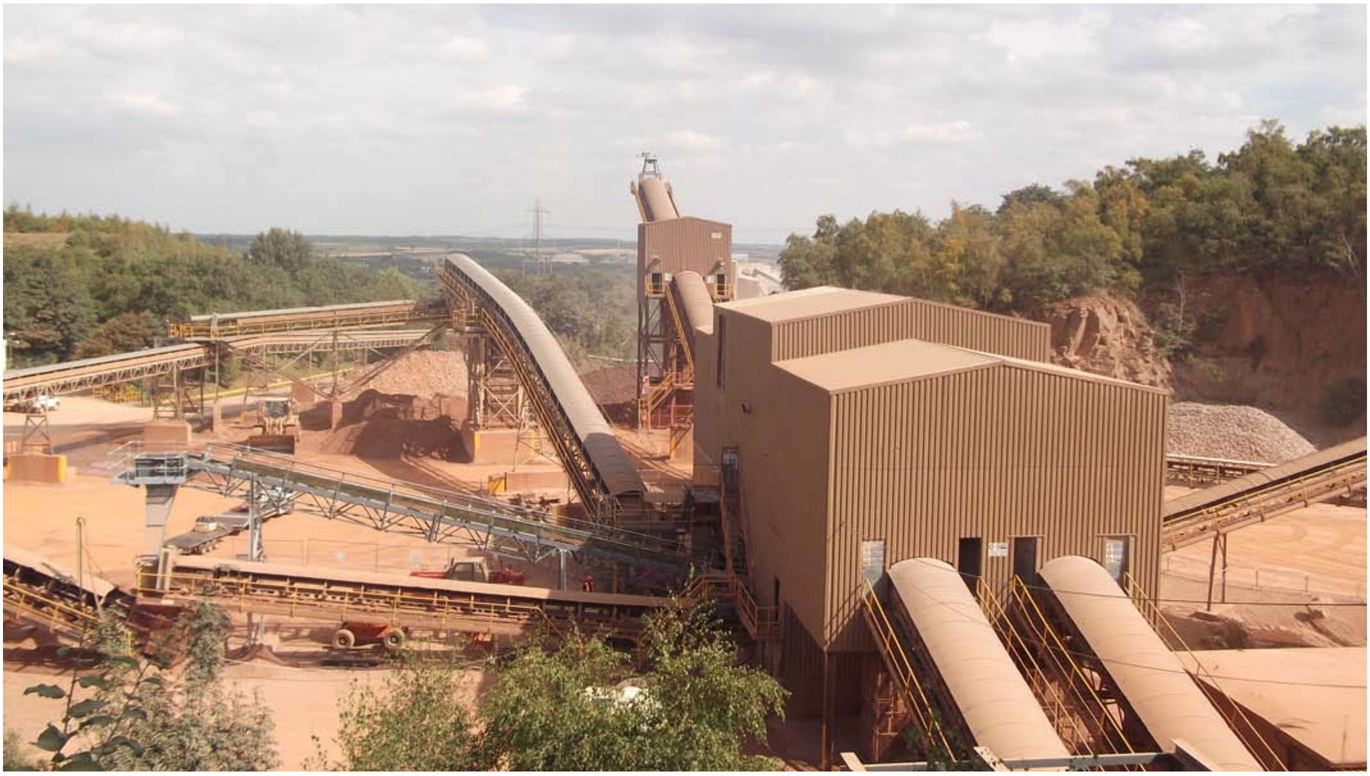
Minerals sites vary significantly in size (ranging from tens of thousands to millions of tonnes per year), type of activity and potential for dust generation (e.g. wet extraction of sand and gravel compared to coal extraction). Notwithstanding this, planning applications for most new mineral developments (or extensions to existing ones) are likely to require a dust impact assessment, either as part of an Environmental Statement or a stand-alone study. This is particularly the case if a quarry covers more than 15 hectares or involves the extraction of more than 30,000 tonnes of mineral per year[2].

Dust arising from the quarry can reduce amenity in the local community due to visible dust plumes and dust soiling. The generally coarser dust that leads to these effects may, therefore, be referred to as 'disamenity dust'[3].

The smaller dust particles can remain airborne longer, potentially increasing local ambient concentrations of suspended particulate matter (e.g. PM_{10} and to a lesser extent $PM_{2.5}$), which is associated with a range of health effects. This guidance uses PM_{10} as the health indicator of airborne particles to be consistent with national Planning Practice Guidance (nPPG[5]) for mineral sites. Mineral site impacts are more likely to be associated with coarse particulate matter (i.e. PM_{10}).

1.2 Potential Impacts and Effects

Emissions of dust to air from minerals sites can occur during the preparation of the land, extraction, processing, handling and transportation of extracted minerals. Emissions can vary substantially from day to day, depending on the level of activity, the specific operations being undertaken, and the weather conditions. The scale of these impacts depends on the dust suppression and other mitigation measures applied.



▲ **Image: © Hugh Datson, DustScan Ltd**

Box 1. Impacts and Effects

The terms 'impacts' and 'effects' are often used interchangeably in Environmental Statements and Dust Assessments. In this document the term '*impact*' has been used to describe a change in suspended particulate matter (PM) concentration or dust deposition and '*effect*' to describe the consequences of any impacts such as to human health or disamenity.

The most noticeable air quality impact likely to arise during minerals activities is dust accumulation resulting from deposition, which can lead to disamenity due to the soiling of surfaces. The most recent survey of complaints to local authorities suggests that only 1% of dust complaints relate to mineral excavations[6].

The other potential air quality impact is the increase in ambient suspended particulate matter (PM) concentrations local to the site. As noted earlier, the PM_{10} fraction is relevant to health outcomes. For quarries most of this suspended dust will be in the coarse sub-fraction ($PM_{2.5-10}$), rather than in the fine ($PM_{2.5}$) fraction.

It should be noted that the national air quality objectives for these pollutants are rarely exceeded close to most mineral sites, as they are typically located in rural areas where there is generally a much smaller contribution from traffic pollution than in urban areas.

1.3 The Need for this Guidance

The national Planning Practice Guidance (nPPG) for England[7] states that:"*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*".

The dust assessment may either be a stand-alone technical study or part of an Environmental Statement which may cover a number of other potential environmental impacts.

As will be seen from the next Chapter of this guidance, the nPPG provides only limited guidance and does not go into detail on the mechanics of dust assessments for minerals planning applications. It is this absence of current detailed guidance on dust assessments, and the need to establish some indicative criteria for describing dust impacts and resulting effects, that is the immediate driver for the development of this IAQM guidance for its practitioner members.

▲ **Image: © Advance Environmental**

1.4 Scope and Limitations

This guidance aims to provide advice on robust and consistent good-practice approaches that can be used to assess the operational-phase dust impacts. This guidance is intended for use in the planning process; it is not intended for other purposes such as Environmental Permitting[8]. The IAQM does not expect practitioners to follow the suggested approach in all circumstances. Other approaches may also be valid provided they are based on sound scientific principles and are appropriate for the application.

There is little peer-reviewed published literature on the impacts of dust from UK mineral sites. Some parts of this guidance are therefore based on the judgement of the Working Group, the members of which have collective experience of working on more than 300 assessment studies for mineral sites.

As well as dust impacts, other aspects of air quality (such as pollution from traffic emissions associated with the development) may need to be assessed; these are outside the scope of this guidance.

This guidance applies to the operational phases of minerals developments[9]. Whilst these (and some waste) sites share some common features with construction activities, minerals sites can be on a significantly larger scale. Therefore, although this minerals guidance document has drawn on certain elements of earlier IAQM construction guidance[10] (the underlying Source-Pathway-Receptor concept is applicable to a wide range of applications), any detailed guidance in this document - particularly on source strength and pathway distances - is specifically intended for use when assessing mineral sites.

Many mineral extraction sites also recycle aggregates and this guidance may also be applicable to such processes where they occur on a mineral site. However the guidance is not considered applicable to other waste operations such as waste transfer stations and landfill sites. Waste activities require an Environmental Permit from the Environment Agency and this guidance is not intended to duplicate or contradict environmental permitting guidance. There may also be point sources present associated with minerals activities, such as road stone coating works. These need to be considered on a site-by-site basis, and are not covered by this guidance.

This guidance is designed specifically for use in England. This is because the devolved authorities have separate planning guidance, such as the Mineral Technical Advice Notes (MTANs) in Wales. However, it is anticipated that IAQM members within Northern Ireland, Scotland and Wales will be able to adapt it appropriately for use in the devolved administrations. Although the vast majority of IAQM members work in the UK, it is recognised that the membership of IAQM is international. Caution should be used in attempting to apply this guidance elsewhere and careful consideration should to be given to its applicability: overseas works are often significantly larger and there are likely to be different climates, working practices and impact assessment criteria.

[1] Bide T., T.J.Brown, S.F.Hobbs and N.Idoine. 2015. United Kingdom Mineral yearbook 2014. British Geological Survey Open Report, OR/15/043. 91pp

[2] Department for Communities and Local Government, 2015. National Planning Policy Guidance on Environmental Impact Assessment. Considering and determining planning applications that have been subject to an EIA, Annex: Indicative screening thresholds. Paragraph 058 Ref ID: 4-058-20150326 Revision Date 26 March 2015.

[3] Very high levels of soiling can also damage plants and affect the diversity of ecosystems. However, close to well managed sites in the UK these effects, if they occur at all, are rare.

[4] Although the main health burden to the population is known to be from the fine $PM_{2.5}$ fraction of suspended particles, there is now evidence that short-term exposure to coarse particles i.e. those between PM_{10} and $PM_{2.5}$, typically associated with mineral activities are also associated with adverse respiratory and cardiovascular effects on health (World Health Organization, 2013. REVIHAAP Project, Technical Report. Copenhagen).

[5] This document uses the abbreviation nPPG to distinguish the current national Planning Practice Guidance from the now-superseded Planning Policy Guidance which was abbreviated to PPG.

[6] Temple, 2012. Local Authority Statutory Nuisance Survey 2011. Report for Defra. http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=16101.

[7] Department of Communities and local Government, 2014. National Planning Policy Guidance on Assessing Environmental Impacts from Mineral Extraction. Paragraph: 023 Reference ID: 27-023-20140306, Revision Date 6 March 2014.

[8] Minerals sites do not themselves require Environmental Permits, although some specific activities (e.g. crushers) and other processes (e.g. road stone coating plant) on the site may require permits.

[9] This guidance applies to solid minerals; it therefore excludes oil and gas.

[10] Institute of Air Quality Management, 2014. IAQM Guidance on the assessment of dust from demolition and construction. London. www.iaqm.co.uk/text/guidance/construction-dust-2014.pdf.

2. Standards, guidance & appeal decisions

This section is not intended to be exhaustive and the reader is encouraged to ensure that the latest standards and guidance are referenced in their assessment

2.1 Dust Standards and Guideline Values

Dust is a generic term covering particles of different compositions, shapes and sizes; these can have different impacts and effects:

- Those particles up to 10 µm (micrometres) in diameter (known as PM_{10}) remain suspended in air for long periods and because they are fine enough to be breathed in and can, potentially, cause health effects;
- The particles that are larger (and maybe visible to the naked eye) are not thought to cause health effects to the same extent, but can cause disamenity through soiling and staining when they deposit onto window ledges, cars, laundry and plants etc.; and
- Dust accumulation[11] can also cause effects on ecological receptors. The potential impacts and effects are described in more detail in later sections of this guidance.

2.1.1 Airborne Concentrations

Statutory standards exist for concentrations of suspended particulate matter (both PM_{10} and the $PM_{2.5}$ fine fraction)[12] , set under The Air Quality Standards Regulations 2010[13] which implement limit values prescribed by the European Directive 2008/50/EC[14]. The limit values are legally binding and the Secretary of State, on behalf of the UK Government, is responsible for their compliance.

Table 1: Summary of Limit Values and Objectives for Suspended Particulate Matter

PM fraction	Averaging period	Objectives/ Limit Value	Max allowable exceedences	Target Date
PM_{10}	24 hours	50 µg/m³	35 times per calendar year	-
	Annual	40 µg/m³		-
$PM_{2.5}$	Annual	Target of 15% reduction in concentrations at urban background locations		Between 2010 and 2020
		Variable target of up to 20% reduction in concentrations at urban background locations		Between 2010 and 2020
	Annual	25 µg/m³		01.01.2020
		25 µg/m³		01.01.2015

2.1.2 Disamenity Dust

In contrast to suspended particulate matter (PM), there are no UK or European statutory standards that define the point when deposited dust causes annoyance or disamenity. This is largely due to the difficultly in accurately determining human response to dust accumulation and soiling. There are a number of "custom and practice" thresholds in use. These however are based on rather old studies, incorporate large corrections and assumptions, are sometimes equipment-specific, and lack validation in current conditions[15]. More recent guidance for the minerals industry recommends that site-specific thresholds should be agreed between the site operator and the local planning authority, appropriate for both the site and its surroundings, taking into account baseline values[16].

Similarly, no firm guidance is available on significance criteria for frequency of disamenity dust episodes. Previous guidance[17] suggested that a community may be prepared to tolerate an incident once a month, but not repeated incidents at frequencies of once or twice a week. There is, however, no contemporary evidence base to support this assumption.

2.2 Planning Policy Background

The National Planning Policy Framework (NPPF)[18] states the Government's policy on planning and is a material consideration for local planning authorities and decision-takers in determining applications. Under the heading *'Facilitating the sustainable use of minerals'*, the NPPF states:

"When determining planning applications, local planning authorities should:

- *ensure, in granting planning permission for mineral development, that there are no unacceptable adverse impacts on the natural and historic environment, human health or aviation safety, and take into account the cumulative effect of multiple impacts from individual sites and/or from a number of sites in a locality; and*
- *ensure that any unavoidable noise, dust and particle emissions and any blasting vibrations are controlled, mitigated or removed at source…".*

The NPPF is supported by the national Planning Practice Guidance (nPPG), including sections focusing on both air quality generally and minerals specifically The Minerals section of the nPPG provides the principles to be followed in considering the environmental effects of surface mineral workings and states that:

"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."

Professional membership of the IAQM or certain other environmental professional bodies is likely to indicate this.

2.3 Planning Guidance on Minerals Dust Assessments

On air quality in general, the nPPG advises that *"Assessments should be proportionate to the nature and scale of development proposed and the level of concern about air quality, and because of this are likely to be locationally specific."* It goes on to advise that supporting information provided for planning applications should:

- *"Assess the existing air quality in the study area (existing baseline);*
- *Predict the future air quality without the development in place (future baseline); and*
- *Predict the future air quality with the development in place (with mitigation)."*

On dust assessment studies specifically, the Minerals section of the nPPG states that:

"There are five 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."*

The main potential impact is that of dust deposited on surfaces. The Minerals section of the nPPG is not prescriptive on how that impact should be assessed, but does describe some specific aspects that should be included:

"The location of residential areas, schools and other dust-sensitive land uses should be identified in relation to the site, as well as proposed or likely sources of dust emission from within the site.

The assessment should explain how topography may affect the emission and dispersal of site dust, particularly the influence of areas of woodland, downwind or adjacent to the site boundary, and of valley or hill formations in altering local wind patterns.

The assessment should explain how climate is likely to influence patterns of dispersal by analysing data from the UK Meteorological Office or other recognised agencies on wind conditions, local rainfall and ground moisture conditions."

It recognises that both qualitative and quantitative assessment approaches have their uses, noting that, *"Computer modelling techniques can be used to understand how dust could disperse from a site. Alternatively, a more qualitative approach, relying on professional judgment, could be used…"*. Detailed dispersion modelling of dust impacts from minerals sites in the UK is extremely rare and is not generally recommended by the IAQM given the lack of accurate UK emissions data for this sector.

For proposed minerals developments meeting certain criteria, the assessment should additionally consider the concentrations of dust particles suspended in the air (PM_{10}) that can potentially have effects on human health, by considering the likelihood of PM_{10} exceeding the Air Quality Strategy objective. The Minerals section of the nPPG states that:

"Additional measures to control fine particulates (PM_{10}) to address any impacts of dust might be necessary if, within a site, the actual source of emission (e.g. the haul roads, crushers, stockpiles etc.) is in close proximity to any residential property or other sensitive use. Operators should follow the assessment framework for considering the impacts of PM_{10} from a proposed site.

The actual cut-off point for consideration of additional assessments for individual proposals will vary according to local circumstances (such as the topography, the nature of the landscape, the respective location of the site and the nearest residential property or other sensitive use in relation to the prevailing wind direction and visibility)".

The referenced assessment framework flow chart (reproduced in **Figure 1**) is more specific and states *"residential properties and other sensitive uses within 1 km of site activities".*

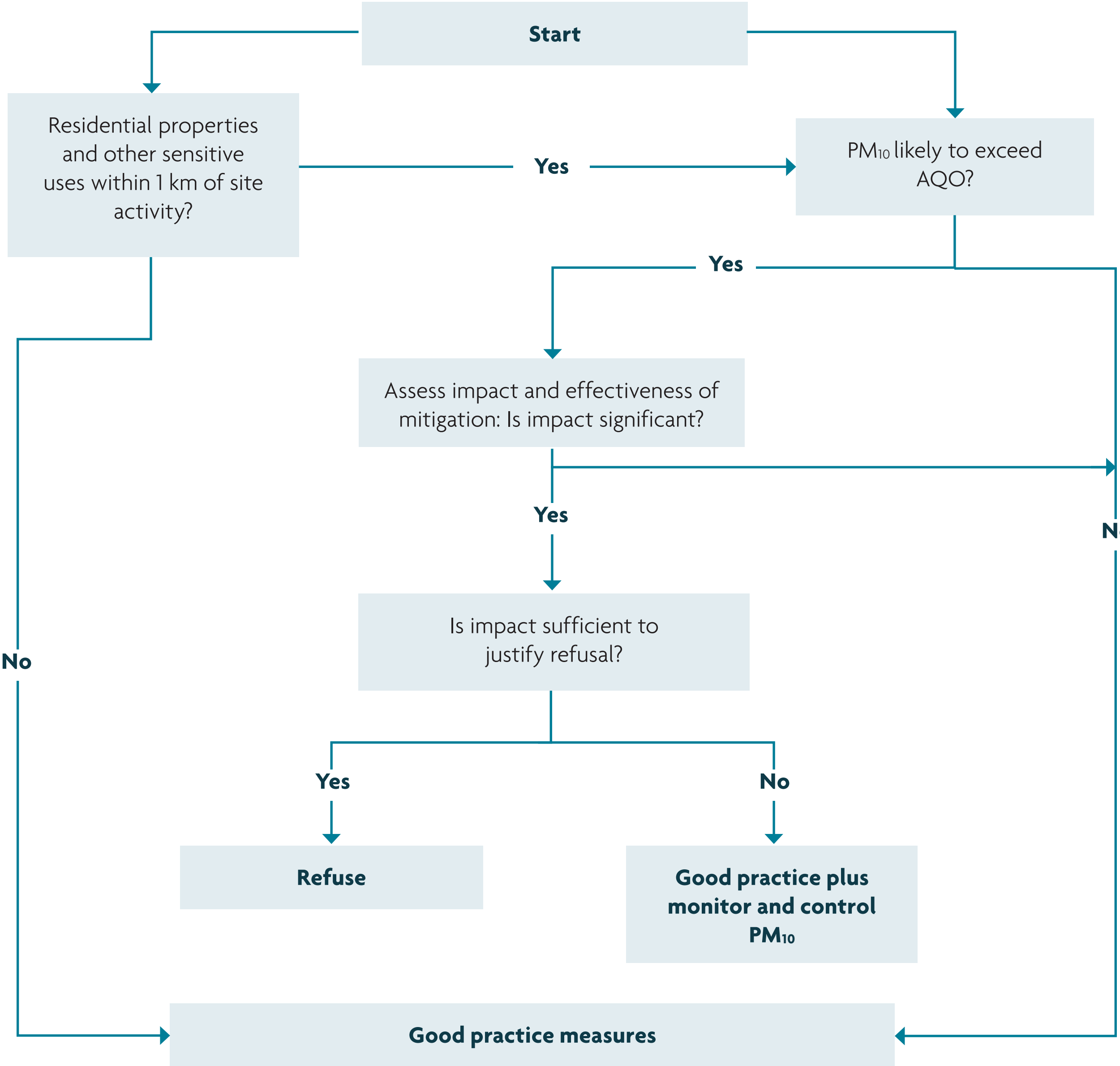
The cited radius of effect of 1 km is based on studies carried out many years ago around open-face coal mines and there appears to be no firm evidence that such a distance can be applied to other minerals developments (most of which involve less dust-generating activity than an open-cast mine) as a screening distance for PM_{10} effects. This is considered in more detail in later sections of this guidance.

2.4 Recent Appeal Decisions

A review of recent appeals indicates that for disamenity dust, the decisions have continued to be based on the research publications that had informed earlier guidance. Examples are provided in **Appendix 1**. These recent decisions, together with others made in England, and supported by similar decisions in the devolved administrations, confirm that there is a general acceptance that dust emissions can be controlled and dust impacts can be adequately mitigated. Planning Inspectors are more likely to decide in favour of an appellant if a range of dust monitoring and control measures is proposed, and the submission of a Dust Management Plan (DMP), or similar, which can be made the subject of a planning condition, will assist in this regard.

▲ **Image: © Advance Environmental**

Figure 1: Site Assessment Flow Chart[19]



[11] The term deposition has been used through this document to refer to the accumulation of dust on a surface of any orientation as the particles are taken out of the air. It is not restricted to vertical deposition to a horizontal surface.

[12] It is widely accepted that the PM_{10} fraction is the suitable metric for suspended dust impacts around quarries and construction sites as these tend to release significant proportions of mechanically-generated coarse-mode particles.

[13] Air Quality Standards (England) Regulations, 2010. Statutory Instrument 2010 No.1001.

[14] Council Directive on Ambient Air Quality and Cleaner Air for Europe, 2008/50/EC, May 2008.

[15] For example different types of deposition gauge have different collection efficiencies.

[16] AEA Technology, 2011. Management, mitigation and monitoring of nuisance dust and PM_{10} emissions arising from the extractive industries: an overview. Report No AEAT/ENV/R3141 Issue 1, February 2011. Harwell.

[17] Office of the Deputy Prime Minister, 2005. Minerals Policy Statement 2: Controlling and Mitigating the Environmental Effects of Minerals Extraction in England Annex 1: Dust.

[18] Department for Communities and Local Government, 2012, National Planning Policy Framework. London.

[19] National Planning Policy Guidance on Assessing Environmental Impacts from Mineral Extraction. Paragraph: 032 Reference ID: 27-032-20140306, Revision Date 6 March 2014.

3. Screen the need for a detailed assessment

Where there are no receptors near to a mineral site there will be no significant effect. Therefore it is possible to screen out the need for a detailed assessment based on the distance from a mineral site to potentially sensitive receptors.

The experience of the Working Group together with published studies and anecdotal evidence on the change in both airborne concentrations and the rate of deposition with distance, suggests that dust impacts will occur mainly within 400 m of the operation, even at the dustiest of sites (see **Box 2** and **Appendix 2**[20].

PM_{10} needs to be assessed if there are sensitive receptors within 1 km (to be consistent with the nPPG); however, for disamenity dust the following simple distance based criteria should be used to determine the requirement for a detailed dust assessment. It is illustrated in **Figure 2**.

Note that distances refer to 'dust generating activities' rather than the site boundary and this may refer to extraction and processing areas or haul roads, for example. For a large site, the operations may only be within the distances described below for a small proportion of the operational phase of the development, in which case separate assessment of two or more phases may be justified.

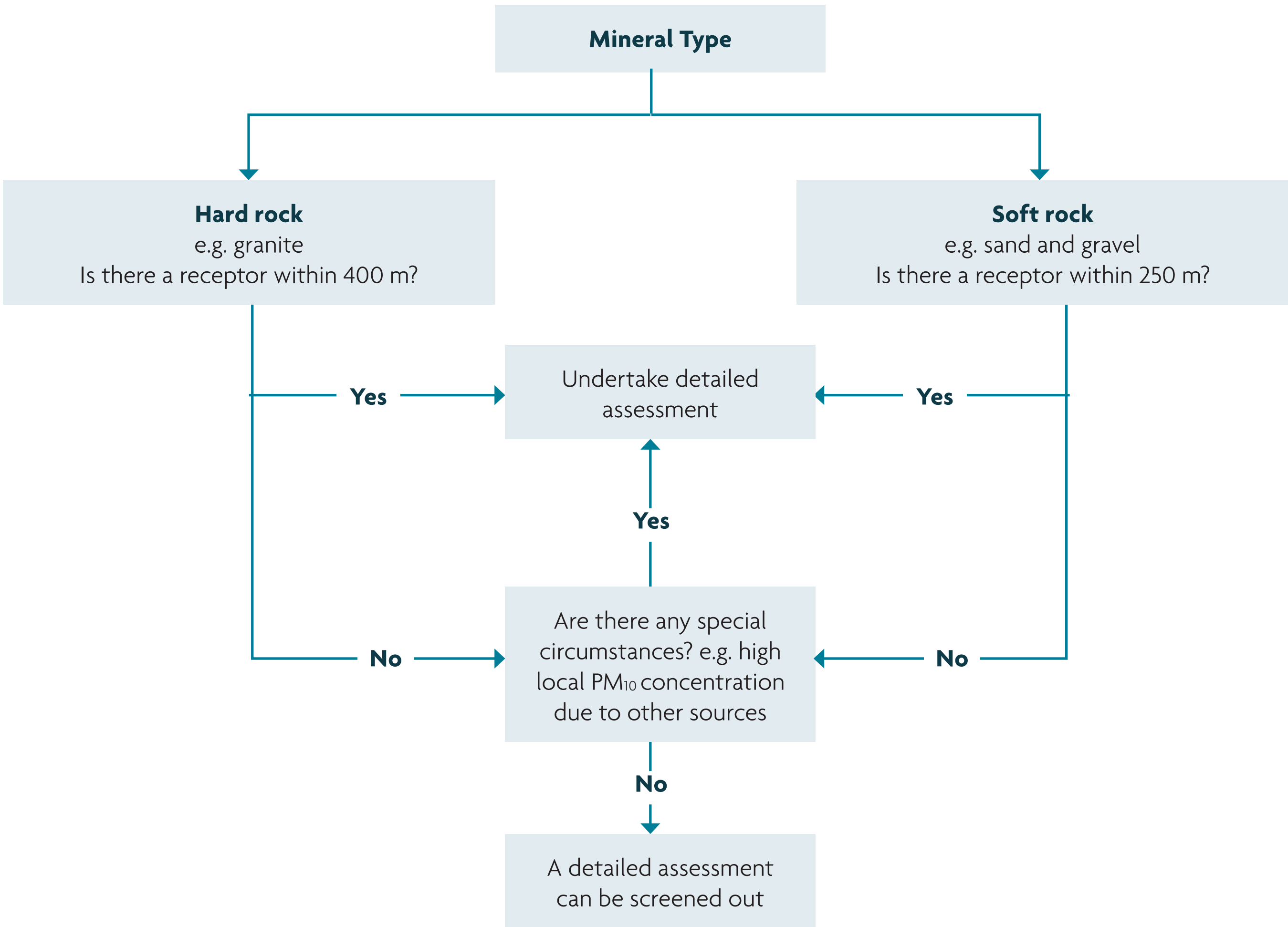
- If there are no relevant receptors within 1 km of the operations, then a detailed dust assessment can be screened out. In such a case, it is considered that irrespective of the nature, size and operation of the site, the risk of an impact is likely to be "negligible" and any resulting effects are likely to be 'not significant'.
- In cases whereby receptors are located between 400 m, or 250 m (depending on the rock type) and 1km of operations, it would normally be assumed that a detailed disamenity dust impact assessment is not required. However, the decision on whether to assess should be made and justified on a site-specific basis by a suitably experienced air quality professional taking into account the factors in **Chapter 6**.
- If there are relevant human and/or ecological receptors within 250 m or 400 m (depending on the rock type) then a disamenity dust impact assessment will almost always be required. This step is deliberately chosen to be conservative (and will in practice result in assessments being required for most minerals development schemes).
- Where the potential dust impact of a mineral site cannot be 'screened out', a more detailed dust assessment will be required.

Box 2. Typical Impacts with Distance

From the experience of the Working Group, adverse dust impacts from sand and gravel sites are uncommon beyond 250 m and beyond 400 m from hard rock quarries measured from the nearest dust generating activities (see **Appendix 2**).

In the absence of other information it is commonly accepted that the greatest impacts will be within 100 m of a source and this can include both large (>30 µm) and small dust particles. The greatest potential for high rates of dust deposition and elevated PM_{10} concentrations occurs within this distance. Intermediate-sized particles (10 to 30 µm) may travel up to 400 m, with occasional elevated levels of dust deposition and PM_{10} possible. Particles less than 10µm have the potential to persist beyond 400 m but with minimal significance due to dispersion.

Figure 2: Screening Flow Chart



[20] Recently published data, albeit from construction not mineral sites, using hourly PM_{10} concentrations suggests that concentrations decline exponentially with distance, and reduced to half their initial concentrations within a few hundred metres downwind. Azarmi F., P Kumar, D.Marsh and G.Fuller, 2015. Assessment of the long-term impacts of PM_{10} and $PM_{2.5}$ particles from construction works on surrounding areas. Environmental Science Processes & Impacts, Publ. RSC. DOI: 10.1039/c5em00549c.

4. Recommended content of a minerals dust assessment

National planning guidance provides some advice on the content of air quality assessments generally and for minerals applications specifically, as described earlier in **Section 2.3**. To meet those expectations in the context of the assessment approach recommended in this guidance document, the IAQM recommends that an assessment of the impact and resulting effects of dust from a minerals development on surrounding users of the land should usually contain the following major elements:

i. A description of the existing PM_{10} concentration (and dust deposition rates where available[21]);

ii. A description of the location of receptors and their relative sensitivities to PM_{10} concentration and dust deposition;

iii. Details of potential dust sources associated with the proposed development, including the activities and materials involved (including a brief outline of quantities, duration, methods of handling and storage, etc.) and the resulting potential for releasing dust, covering fugitive sources, diffuse sources and point sources as applicable;

iv. A description of the control/mitigation measures incorporated into the scheme (including design features, management controls (e.g. Dust Management Plan) and, where appropriate, engineering controls);

v. A prediction, using appropriate assessment tools, of the likely PM_{10} and dust deposition impacts and resulting effects (on health, amenity, and/or ecology) at relevant sensitive receptors, and taking into account the following:

a) The likely magnitude of dust emissions (after control by measures incorporated into the scheme);

b) the likely meteorological characteristics at the site;

c) the dispersion and dilution afforded by the pathway to the receptors, taking into account distance, orientation, local terrain and features, and other relevant factors;

d) the sensitivity of the receptors to disamenity, health and/or ecology effects; and

e) any likely cumulative interactions.

vi. The residual PM_{10} and dust deposition impacts and their disamenity, health and/or ecology effects;

vii. A conclusion on the significance of the overall residual air quality effect, i.e. whether "significant" or "not significant";

viii. Where the effects are assessed as significant, appropriate further mitigation (including modification of site design) and control measures that could allow the proposal to proceed without causing significant adverse effects; and

ix. Proposals, where appropriate, for proportionate dust monitoring and reporting to check the ongoing effectiveness of dust controls and mitigation, check compliance with appropriate environmental standards and to enable an effective response to complaints.

Where the mineral development is an extension of an existing site, is close to another mineral site, or other dust generating sources, the cumulative impacts may need to be considered.

[21] There is less of an imperative for gaining a highly accurate measure of baseline dust deposition rates, as this information is not required for the qualitative assessment of disamenity effects that will usually be used.

5. Assessing the dust impacts and effects of minerals developments

5.1 Deposited Dust - General Approach

The Defra Green Leaves III guidance[22] describes the Government`s recommended generic guidelines for the assessment and management of environmental risks. The Source-Pathway-Receptor (S-P-R) concept presents the hypothetical relationship between the source (S) of the pollutant, the pathway (P) by which exposure might occur, and the receptor (R) that could be adversely affected. The dust impact at relevant receptors should be predicted using this concept. This approach is applicable to both the disamenity and the ecological effects of deposited dust.

Estimates (measurements or approximations) are required for dust emissions from the source and a technique to forecast how the dust will disperse and dilute in the air and what the resultant dust levels are likely to be at local receptors. This uses the Residual Source Emissions, that is the potential dust emissions after designed-in mitigation measures have been taken into account.

Predictive techniques vary in their sophistication, cost and in how quantitative the predictions will be; they include:

- Qualitative (risk-based) dust assessments;
- Simplified modelling, such as screening models, look-up tables and nomographs; and
- Fully quantitative atmospheric dispersion modelling.

The collective view of the IAQM Working Group is that it is currently inappropriate to use a quantitative modelling approach to predict the impact in most cases and a qualitative risk-based approach using the S-P-R concept should usually suffice. This is primarily due to a lack of UK derived emission factors for minerals sites that could be used for modelling.

Step 1: Describe Site Characteristics and Baseline Conditions

IAQM recommends that the site is visited at the beginning of the assessment to understand the site itself and its locality including local factors that can affect dust emissions and dispersion.

The proposed development and the surrounding area should be described. Factors that need to be taken into account are (based on AEAT, 2011)[16]:

- Extent of site including site boundary;
- Existing site operations, including currently-consented workings;
- Scale and duration of operations, including phasing;
- Type and location of processing activities, including secondary processing (e.g. concrete batching);
- Mineral type and characteristics (size, moisture content, friability, colour, and opacity);
- Production rate;
- Method/s of working;
- Method/s of materials handling;
- Location/s of storage areas and stockpiles; and
- Location/s and number of access routes and haul roads.

The assessment should also take into account the principal existing dust sources (other than the application site) such as dust from existing mineral operations, agricultural activities and construction activities.

The following information is likely to be required to understand the site characteristics and the baseline conditions:

- The main existing sources of dust in the area. This should include any available monitoring data;
- Background PM_{10} concentrations provided by Defra, and, if available, any existing relevant local monitoring data;
- The location and nature of dust sensitive receptors, shown on a map and/or in a table detailing the direction, and distance from the site boundary or relevant site activity;
- The location of likely sources of dust emission from within the site;
- Any natural or existing mitigating features such as topography and areas of vegetative screening; and
- Local wind roses showing the frequency of directions and speed, and possibly rainfall and ground moisture conditions.

Step 2: Estimate Dust Impact Risk

The Dust Impact Risk for each representative receptor needs to be determined. **Table 2** shows how the Source term and the

Pathway term can be combined to estimate the risk of dust impacts at individual receptors.

As the Dust Impact Risk predicted in any given case is wholly dependent on the categories assigned to the Source term and the Pathway term, it is crucial that practitioners justify within their report the particular categorisations they have chosen, drawing on the important factors (described in **Chapter 6)** that influence these terms. Various schemes have been used by IAQM members to determine the Source term and the Pathway term and **Appendix 3** gives one such illustrative example of a Dust Disamenity assessment procedure. Whether this or other schemes are used, they should all follow the underlying S-P-R concept and be robust and based on sound scientific principles.

Where there is uncertainty or in the assessors' judgement a site lies between categories a precautionary approach should be adopted and the higher category used. The assessment should typically be based on the closest point of a receptor to a potential dust generating activity.

Some guidance is provided in **Appendix 4** on categorising the residual source emissions.

Step 3: Estimate Likely Magnitude of Effect

The likely Dust Impact Risk predicted at each representative receptor then needs to be considered together with the sensitivity of that receptor, to give the likely magnitude of the effect that will be experienced (**Boxes 3** and **5** in **Chapter 6** show the sensitivities of relevant receptors to disamenity and ecological effects, respectively). For disamenity this effect can include annoyance or even nuisance from soiling of clean surfaces such as window sills, cars or laundry.

There is relatively little available evidence of the effect of dust deposition. That available, however, points to disamenity (to people and property) occurring at significantly lower levels of dust deposition than that which may adversely affect plants. For assessing the ecological effects resulting from the predicted dust impact, it may be necessary to consult an ecologist.

For disamenity, gauging the magnitude of the effect that results from the predicted dust impact on a receptor of a particular sensitivity is a matter of judgement that cannot easily be defined by scientific methods alone. Most practitioners would agree that a high sensitivity receptor subject to a high dust impact will experience a substantial adverse effect and a low sensitivity receptor subject to a low dust impact will experience a negligible effect. However, between these extremes the various combinations will give rise to a gradation of effects for which no descriptor terms have been universally agreed. The IAQM proposes the following framework of descriptors for the magnitude of disamenity effects for receptors of different sensitivities receiving different dust deposition impacts, based on the *IAQM guidance on the assessment of odour for planning*[23]. This framework will be kept under review to benefit from the feedback of affected or interested parties, be they air quality practitioners, EIA specialists, planners, or communities.

Table 2. Estimation of Dust Impact Risk

		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

Table 3. Descriptors for Magnitude of Dust Effects

	Receptor Sensitivity		
	Low	**Medium**	**High**
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 Risk	Slight Adverse Effect
Negligible Risk	Negligible Effect	Negligible Effect	Negligible Effect

Having predicted the magnitude of the likely effect from dust deposition at individual, representative receptors, the next step for most assessments for planning purposes will be to estimate the overall effect from dust deposition on the surrounding area, taking into account the different magnitude of effects at different receptors, and the number of receptors that experience these different effects[24]. This requires a competent and suitably experienced Air Quality Practitioner to apply professional judgement. A separate estimate of the overall disamenity effect and the overall ecological effect (where relevant) is required.

5.2 Suspended Particulate Matter - General Approach to Assessing the Health Effects

The main potential effect from mineral sites is disamenity due to dust deposited on surfaces. The minerals section of the nPPG[25] however, states that if there are residential properties (or other sensitive uses) in close proximity to the source of emission (e.g. haul roads, crushers, stockpiles, etc.) on the mineral site, then the dust assessment study should additionally consider the concentrations of dust particles suspended in the air (PM_{10}) that can potentially have effects on human health by considering the likelihood of PM_{10} exceeding the Air Quality Objectives.

The IAQM recommends the PM_{10} dust assessment includes the following key elements:

1. Determine the existing background ambient concentration of PM_{10}. This can be based on publically available background data, or where this is not adequate from site-specific monitoring data. The reason behind the choice of data used should be clearly stated. If the long term background PM_{10} concentration is less than 17µg/m³ there is little risk that the Process Contribution (PC) would lead to an exceedence of the annual-mean objective and such a finding can be put forward qualitatively, without the need for further consideration, in most cases. This will obviously depend on the distance between dust generating activities on the site and the closest receptor, the type of quarry/mine and designed mitigation measures. If this is the case there would be no need for the detailed consideration of Steps (2) to (6).

Evidence provided by the Minerals Guidance Working Group (shown in **Appendix 2)** suggests that the maximum annual mean PC is likely to be around 15 µg/m³ although occasionally it can be greater. The value of 17 µg/m³ is derived by extracting 15 µg/m³ from 32 µg/m³. The latter value is that provided in LAQM (TG16) as an indication of the relationship between annual mean concentrations and the risk of the daily PM_{10} objective being exceeded. Based on the currently available information 17 µg/m³ is considered to be a suitable screening value for an assessment of annual mean PM_{10} concentrations[26].

There may be a number of days per year with particularly intense operations which increase the number of days with a concentration greater than 50 µg/m³ but do not have a significant impact on annual mean concentrations. While the current lack of published data/evidence on short-term process contributions (PCs) persists, the IAQM recommends the focus in assessments should be on the annual mean objective.

2. Estimate the expected PC of PM_{10} at the sensitive receptors that comes from the site activities (see **Appendix 5**). In many cases, this can be done semi-quantitatively, using published estimates of the likely PM_{10} addition locally from this type of activity.

3. Estimating the total predicted environmental concentration (PEC) by adding the PC and background PM_{10} concentration (see **Appendices 2** and **4**).

4. Comparing the PEC with the annual mean objective for PM_{10}.

5. Determine the overall PM_{10} impact on the surrounding area. The significance of this overall PM_{10} impact (i.e. whether it is "significant" or "not significant") is determined using professional judgement, for example a "moderate" impact at one receptor may not mean that the overall impact has a significant effect and other factors need to be considered. Further guidance is provided in the Environmental Protection UK/ IAQM guidance on Land-use Planning & Development Control: Planning for Air Quality[27].

5.3 Conclusion on the Significance of Residual Dust Effects

From **Sections 5.1** and **5.2**, the assessor will have derived separate estimates of the overall disamenity and, where required, the ecological and health effects. From this, a conclusion must be reached on the likely significance of the air quality effects collectively (also considering traffic pollutants in those cases where vehicle emissions have come within the scope of the assessment[28]). This is a binary judgement: either it is "significant" or "not significant".

This stage requires the application of professional judgement by a competent, suitably qualified and experienced air quality professional. As well as weighing up the degree to which adverse disamenity, health and ecological effects will be experienced at different numbers and types of receptors, particular consideration needs to be given to factors emphasised in national planning guidance. The PPG advises that in considering planning permission, the relevant question for air quality is *"will the proposed development (including mitigation) lead to an unacceptable risk from air pollution, prevent sustained compliance with EU limit values or national objectives for pollutants or fail to comply with the requirements of the Habitats Regulations?"*

▲ **Image: © Hugh Datson, DustScan Ltd**

The above assessment of impacts and their effects will have been carried out based on the residual emissions from the development taking account of the controls that are incorporated into the design of the submitted scheme. If the outcome of the assessment is that the air quality effect is "not significant" then it is likely that these controls will be sufficient. If, on the other hand, the assessment predicts the impacts and their effects are likely to be "significant" then it is likely that additional mitigation will be required, to a proportionate degree to sufficiently reduce the impacts. Dust control and mitigation measures are discussed in **Chapter 7**.

22 Department for Environment, Food and Rural Affairs, 2011. Guidelines for Environmental Risk Assessment and Management: Green Leaves III, November 2011.
23 Institute of Air Quality Management, 2014. Guidance on the assessment of odour for planning. London. www.iaqm.co.uk/text/guidance/odourguidance-2014.
24 Unless there are only a few local receptors, then a representative selection of receptors will have been used in the assessment. This final stage of considering the overall effect needs to take into account how many receptors these selected ones represent.
25 Department for Communities and Local Government, 2014. National Planning Policy Guidance on Assessing Environmental Impacts from Mineral Extraction. Paragraph: 030 Reference ID: 27-032-20140306, Revision Date 6 March 2014. London.
26 Defra's Local Air Quality Management Technical Guidance (LAQM.(TG16)) uses the following screening criteria: 200 m from a fugitive dust source and a back-ground PM_{10} concentration of 28µg/m³. The basis of the TG16 criteria is not provided. As receptors may be within 200m of a mineral site a more conservative screening approach has been adopted in this IAQM guidance.
27 EPUK/IAQM, Land-use Planning & Development Control: Planning for Air Quality, London. Available from iaqm.co.uk.

6. Factors influencing the risk of dust impacts

6.1 Categorising the Source, Pathway and Receptor Terms
The previous chapter described how the risk of dust impacts from any given minerals development proposal, and any resulting adverse effects, depended on: the level of dust emissions from the site (the Source); the effectiveness of transport through the air (the Pathway), and the sensitivity of surrounding land users (the Receptors) that could be exposed. The important factors that need to be considered in categorising the S, P and R terms are summarised below.

6.2 Factors Influencing the Residual Source Emissions
The scale and nature of the works will determine the level of residual (i.e. abated) dust emissions from fugitive sources, diffuse sources and, if applicable, point sources associated with the development. The judgement on the categorisation of the Source term will need to take into account the emission potential of each of the sources on the site (including source strength, frequency and duration) and how effectively they are likely to be controlled by designed–in measures proposed as part of the scheme. Specific factors include:

- the activities being undertaken (blasting, crushing, screening, methods of handling and storage, etc.);
- the types and properties of the materials involved;
- the size of the site and, specifically, the area of land being worked (and hence the quantities of materials involved and the number of vehicles and plant etc.);
- the durations and frequencies of the activities;
- the likely effectiveness of the dust control measures incorporated into the design of the submitted development scheme, including design features, management controls (ideally formalised within a Dust Management Plan) and, where appropriate, engineering controls;
- other mitigation measures applied to reduce or eliminate dust; and
- the meteorological conditions that can promote or inhibit the raising of dust at the source (high winds and rainfall, respectively).

Further information on these factors is given below.

6.2.1 Activities being undertaken
The following seven types of dust-generating activities on mineral extraction sites are likely to have the greatest potential for dust emissions:
a) Site preparation/restoration (including soil and overburden handling);
b) Mineral extraction (including blasting);
c) Materials handling (e.g. loading onto haul trucks or conveyors);
d) On-site transportation (haul roads);
e) Mineral processing (e.g. crushing and screening);
f) Stockpiling/exposed surfaces; and
g) Off-site transportation (e.g. leading to trackout onto external road network).

It is not usually possible to predict with any degree of certainty when particular work activities will take place and whether these will coincide with high-risk meteorological conditions (see further details below). It is usual therefore to make assumptions; a worst case would be to assume that for those periods when winds are blowing from the site to receptors, those specific site activities that generate dust will be occurring. In practice this is unlikely to always be the case.

6.2.2 Materials
The type of material being extracted and processed can have a significant influence on potential emissions. Sand and gravel deposits may possess an inherently high moisture content, which can cause particles to adhere and thereby affords a high degree of natural mitigation. However, this does not negate the potential for fugitive emissions from this material if it dries out, especially during high wind conditions. Conversely, the extraction and processing of hard rock such as granites and limestone can more readily generate dust, which requires appropriate mitigation.

Particle size distribution of the material is particularly important to dust emissions from vehicles passing over unpaved ground, as well as the speed and weight of the vehicle, the moisture content of the material, the distance covered and the frequency of vehicle movements.

High levels of PM_{10} may be associated with high levels of deposited dust. However, there is no direct correlation between

▲ **Image: © Hugh Datson, DustScan Ltd**

the two; indeed, as airborne particles fall out of the parcel of dust-laden air, the suspended PM concentration is reduced. The relative proportions of size fractions that deposit quickly compared to those that stay suspended for lengthy periods is determined by the materials and activities involved. Mineral type can dictate the potential influence on PM_{10}. Extraction of material with a high moisture content, such as sand and gravel, can potentially generate a smaller impact than the percussive processes associated with hard rock. The particle size and/or processes associated with specific minerals can also generate PM_{10}, for example, the inherently small particle size of clay.

6.2.3 Dust control measures incorporated into the design

Individual mineral site design and associated environmental management can significantly influence the fugitive emissions of dust generation. This can limit the capability of precise dust impact prediction as each site is distinct. Ideally, the various dust control measures and management controls should be described in a formal Dust Management Plan document (see **Appendix 6** for the IAQM's recommendation on what a DMP should contain).

6.2.4 Meteorological conditions

High wind speeds increase the likelihood of dust being raised and blown from the site. Dry materials are more easily raised into the air and so rainfall acts as a natural dust suppressant. High-risk meteorological conditions are, therefore, when the wind is coming from the direction of the dust source[28] at a sufficient strength, during periods of little or no rainfall (often taken as <0.2 mm per day) especially during periods when evaporation exceeds rainfall and drying conditions prevail. The threshold wind speeds for initiation of wind blow[29] can range from 2.4 m/s (Force 2, "light breeze") up to gale force, depending on the particle size and the condition of the surface[30] but moderate breeze, 5.5 m/s and above, is sometimes used as a general threshold. It is preferable to use a wind blow initiation wind speed specific to the mineral type.

Due to the variability of the weather, it is impossible to predict what the weather conditions will be when specific activities are being undertaken, so it is common practice to use either a worst-case approach (assuming the high-risk meteorological conditions exist for all working activities) or a probabilistic approach (assuming the high-risk meteorological conditions occur for a particular percentage of the time).

Impacts during the summer and winter months are generally different, and if it can be guaranteed that certain activities or those at a specific location will take place during a particular season (with this enforced through a planning condition, for example), consideration could be given to using seasonal wind and rainfall data. However, this type of guarantee is not usual because the demand for minerals is not usually seasonal.

Large scale physical features such as rivers, valleys and hills can influence wind direction over a large area, as can be seen in the wind roses for certain Met Office meteorological stations, for example the influence of the Severn Estuary on wind at Bristol and Cardiff airports and the Pennines at Manchester Airport. Therefore the use of wind data from the nearest meteorological station to the site under consideration may be influenced by the terrain and not represent local conditions. Expert judgement is required to choose the most representative meteorological station, or whether there is a need for site specific data. This could be informed by looking for signs of the prevailing wind, such as the shape of trees, during the site visit.

6.3 Factors Influencing the Pathway

The primary factor influencing the Pathway is the distance between the sensitive receptor and the dust sources. However, other factors can cause a higher or a lower category to be assigned then would be the case based on distance alone. These factors include:

- orientation of receptors relative to the prevailing wind direction; and
- topography, terrain and physical features.

6.3.1 Distance between dust source and receptors

The dust that has become suspended in the air will dilute, disperse and deposit from the air (as deposited dust) with the resultant airborne PM concentration decreasing rapidly as a function of distance from its source (see **Appendix 2**). In general, smaller particles have the potential to be entrained within airflow for longer, thereby dispersing over a wider area.

6.3.2 Orientation of receptors relative to the prevailing wind direction

Dust impacts can occur in any direction from the site; they are, however, more likely to occur downwind of the prevailing wind direction and close to the boundary[31]. Although, overall, receptors in the prevailing downwind direction tend to be at higher risk of dust impact, this is a simplification: it should be noted the "prevailing" wind direction is usually the most frequent direction over a long period such as a year; whereas activity may only occur at a specific location over a period of weeks or months during which the most frequent wind direction might be quite different; furthermore, the most frequent wind direction may also not be the direction from which the wind speeds are highest[32]. The use of the prevailing wind direction in the assessment of risk is most useful, therefore, for activities of long duration such as processing carried out in dedicated areas, rather than activities such as extraction which may only occur at a specific location for a matter of weeks or months.

A more refined picture of this important factor in the effectiveness of the Pathway term can be obtained by considering the frequency that the receptor is downwind of the dust source. The percentage frequencies of winds blowing from the sources to the relevant receptors can be calculated from suitable meteorological data.

It should be noted that when strong winds occur from non-prevailing wind directions disamenity can occur if robust mitigation measures are not in place.

▲ **Image: © Rachel McHale, SLR Consulting Limited**

6.3.3 Terrain and physical features

The local terrain and natural and built features between the source and the receptor can variously act as barriers, reduce airborne concentrations due to impaction, lengthen pathways, affect air flow and increase or inhibit dispersion and dilution. Examples include trees and woodland, escarpments, hills and valleys, bunds, buildings/structures and trees.

6.4 Receptors

Boxes 3, 4 and **5** provide guidance on how to categorise the dust sensitivities of different receptors to disamenity, human health and ecological effects, respectively. These are the same categorisations used in other guidance (specifically the IAQM demolition and construction dust assessment guidance[8]), which is entirely appropriate as the dust sensitivity of a receptor is an inherent property and not one that is dependent on the type of development being assessed. As always, the specific circumstances should be taken into account and may mean that on some occasions particular receptors may not automatically fall into the example categorisations given in **Boxes 2**, **3** and **4**. Further discussion on this is given below.

A 'human receptor' refers to any location where a person may experience the disamenity effects of dust, or the health effects from exposure to PM_{10}. The latter should take account of the time period relevant to the air quality objectives, as defined in the Government's technical guidance for Local Air Quality Management[33].

In terms of disamenity effects, residential dwellings are considered highly sensitive. In some instances, industrial and commercial premises may be considered highly sensitive receptors if they are particularly vulnerable to soiling effects. The latter may include, for example, vehicle showrooms, food manufacturers and electronics manufacturers. The sensitivity will relate to the level of amenity that can be reasonably expected. For example, dwellings and schools are more sensitive than industrial units or farms. Care should be taken to ensure that the assessment takes into account whether exposure will arise in practice (e.g. computer chip manufacture is sensitive to dust and so premises are likely to have extensive dust filtering equipment, although the frequency of filter changes may need to be increased).

▲ Image: © Advance Environmental

An 'ecological receptor' refers to any sensitive habitat affected by dust deposition. This includes the direct impacts on vegetation or aquatic ecosystems, and the indirect impacts on fauna (e.g. on foraging habitats). For locations with a statutory designation, e.g. Special Areas of Conservation (SACs) and Sites of Special Scientific Interest (SSSIs), consideration should be given as to whether the particular site is sensitive to dust and this will depend on why it has been designated. Some non-statutory sites (i.e. local wildlife sites) and/or locations with very specific sensitivities may also be considered if appropriate. The level of dust deposition likely to lead to a change in vegetation is very high (over 1 $g/m^2/day$[34]) and the likelihood of a significant effect is therefore very low except on the sites with the highest dust release close to sensitive habitats. Notwithstanding this, the inclusion or exclusion of sites should be justified in the assessment.

[28] For receptors ≤30 m of the site, it has been assumed that they would be affected during any wind direction, which will be a conservative assumption.
[29] Wind blow is the suspension of dust by the wind from the exposed surfaces e.g. within the extraction area, and stockpiles.
[30] Arup Environmental, Ove Arup and Partner, 1995. The Environmental Effects of Dust from Surface Minerals Workings, HMSO, London (ISBN 11 75 3186 3).
[31] For receptors very close to sources the worst-case assumption, that they would be affected during any wind direction, could be made.
[32] High wind speeds, as well as raising dust (including that previously deposited), can better disperse and dilute the suspended dust.
[33] Department of the Environment, Food and Rural Affairs, 2016. Local Air Quality Management Technical Guidance LAQM.TG(16).
[34] Farmer, A M, 1993. The effects of dust on vegetation – a review. Environmental Pollution 79, 63-75.

Box 3. Sensitivities of People to Dust Soiling Effects

For the sensitivity of people and their property to soiling, the IAQM recommends that the air quality practitioner uses professional judgement to identify where on the spectrum between high and low sensitivity a receptor lies, taking into account the following general principles:

High sensitivity receptor

- users can reasonably expect[a] enjoyment of a high level of amenity; or
- the appearance, aesthetics or value of their property would be diminished by soiling; and the people or property would reasonably be expected[a] to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land.
- indicative examples include dwellings, medium and long term car parks[b] and car showrooms.

Medium sensitivity receptor

- users would expect [a] to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or
- the appearance, aesthetics or value of their property could be diminished by soiling; or
- the people or property wouldn't reasonably be expected [a] to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land.
- Indicative examples include parks, and places of work.

Low sensitivity receptor

- the enjoyment of amenity would not reasonably be expected[a]; or
- there is property that would not reasonably be expecteda to be diminished in appearance, aesthetics or value by soiling; or
- there is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land.
- Indicative examples include playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks[b] and roads.

a. People's expectations will vary depending on the existing dust deposition in the area.

b. Car parks can have a range of sensitivities depending on the duration and frequency that people would be expected to park their cars there, and the level of amenity they could reasonably expect whilst doing so. Car parks associated with work place or residential parking might have a high level of sensitivity compared to car parks used less frequency and for shorter durations, such as those associated with shopping or errands. Cases should be examined on their own merits.

Box 4. Sensitivities of Human Receptors to the Health Effects of PM_{10}

For the sensitivity of people to the health effects PM_{10}, the IAQM recommends that the air quality practitioner assumes that there are three sensitivities based on whether or not the receptor is likely to be exposed to elevated concentrations over a 24-hour period, consistent with the Defra's advice for local air quality management (Defra. 2009, LAQM Technical Guidance LAQMTG.O9).

High sensitivity receptor

- locations where members of the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day)[a].
- indicative examples include residential properties. Hospitals, schools and residential care homes should also be considered as having equal sensitivity to residential areas for the purposes of this assessment.

Medium sensitivity receptor

- locations where people are occupationally exposed over a full working day[b].
- indicative examples include offices, warehouses and industrial units.

Low sensitivity receptor

- locations where human exposure is transient[c].
- Indicative examples public footpaths, playing fields, parks and shopping streets.

[a.] This follows Defra guidance as set out in LAQM.TG(16).
[b.] The air quality objectives and limit values do not apply to occupational exposure, but individuals may still be affected.
[c.] There are no standards that apply to short-term exposure, e.g. one or two hours, but there is still a risk of health impacts, albeit less certain.

Box 5. Sensitivities of Receptors to Ecological Effects

A Habitat Regulation Assessment of the site maybe required as part of the planning process, if the site lies close to an internationally designated site[a].

Professional judgement is required to identify where on the spectrum between high and low sensitivity a receptor lies, taking into account the likely effect and the value of the ecological asset. A habitat may be highly valuable but not sensitive, alternatively it may be less valuable but more sensitive to dust deposition. For the sensitivity of ecosystems to dust deposition the IAQM recommends that an ecologist is consulted to determine the potential effects on plant communities.

High sensitivity receptor

- locations with an international designation and the designated features may be affected by dust soiling
- locations where there is a community of a particularly dust sensitive species such as vascular species included in the Red Data List For Great Britain.
- an indicative example is a Special Area of Conservation (SAC) designated for acid heathlands adjacent to a minerals development releasing alkaline dusts.

Medium sensitivity receptor

- locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown;
- nationally designated site and the designated features may be affected by dust deposition; or indicative examples include Sites of Special Scientific Interest (SSSIs) or a local wildlife sites with very specific sensitivities

Low sensitivity receptor

- locations with a local designation where the features may be affected by dust deposition.
- an indicative example is a local Nature Reserve with dust sensitive features.

[a.] Special Conservation Areas (SAC) and Special Protection Areas (SPA) designated under the Habitats Directive (92/43/EEC) and RAMSAR sites
[b.] Cheffing C. M. & Farrell L. (Editors) (2005), The Vascular Plant. Red Data List for Great Britain, Joint Nature Conservation Committee

7. Mitigation

All minerals sites will encompass a degree of dust mitigation as part of normal working practice. Where an assessment shows however, that there is the potential for a dust impact which is significant, further mitigation must be considered, as described in the nPPG.

Mitigation measures may therefore be divided into two categories.

a) *Basic good practice mitigation measures:* These should apply to all mineral extraction sites; and

b) *Site-specific mitigation measures:* The dust risk categories for each of the seven activities (see **Section 6.2.1**) should be used to define the appropriate, site-specific mitigation measures to be adopted. Appropriate measures, commensurate with the dust risk identified in the assessment, to reduce the dust impact to an acceptable level should be adopted by the operator. No generic guidance has been provided here on site-specific mitigation measures as the risk for each site and its location will be different and professional judgement is required.

In the minority of cases where the activities on a minerals site are covered by an Environmental Permit, the Local Authority or the Environment Agency may have specific mitigation requirements, which should be taken into account during the development of mitigation measures.

7.1 Basic Good Practice Mitigation Measures

7.1.1 Dust Management Plan (DMP)

A Dust Management Plan (DMP) should be prepared and agreed with the stakeholders for implementation on-site (see **Appendix 6**).

7.1.2 Site Design and Planning

Careful planning is required to design the mineral extraction site from an environmental protection perspective. With design controls, dust mitigation forms an integral part of the configuration of the site. Both design-stage and operational (see below) aspects of dust management are complementary, and work together to reduce the potential for excessive levels of dust to be generated at the site.

Table 4 is a summary of site design measures.

7.1.3 Operational Control Measures

Table 5 shows a summary of operational measures that may be used to manage dust emissions from minerals sites. The following advice should be considered although it should be noted that not all measures apply to every site.

The scale and nature of dust mitigation measures applied should be commensurate to the risk of dust impact from the site. Dust mitigation is a dynamic process involving the review and regulation of the mitigation applied as per the conditions on site. Such measures include restriction of some of the working areas, but may also include in extreme cases ceasing the site activities until the dust levels return to their normal levels. Given the size of the mineral extraction sites, it may be possible to carry out activities elsewhere on the site whilst ceasing an activity at a particular part of the site.

▲ **Image: © Advance Environmental**

Table 4. Good Practice Mitigation – Design Measures

	Description
Phasing of extraction activities	Consideration should be given to the relationship of site activities to sensitive locations outside the site. As far as practicable, dust-generating activities should be located away from high and medium sensitive receptors. It is important that the minimisation of dust through site design is addressed for each phase of the works operation.
Design and location of dust-generating activities	Dust-generating activities should, where possible, be located where maximum protection can be obtained from topography, woodland or other sheltering features. Stockpiles, haul roads, tips and mounds, and exposed areas should be located as far away as possible from sensitive receptors. Where practicable, they should not be located directly upwind of the sensitive receptors.
Provision for dust mitigation measures	For longer periods of activity, perimeter screening bunds (ideally vegetated) or semi-permeable fences, and over shorter periods netting screens may be effective. If adequate protection is not provided by requirements for landscaping works, then consideration should be given to the need for a zone adjacent to the perimeter within which works are not conducted (i.e. create a “sensitive zone”, which might also be known as a standoff distance, separation zone or buffer zone). Planning and design of the scheme should make provision for water supply to meet the site demand for mitigation and damping.
Equipment and vehicles	The site should be designed to minimise haul route distances and to locate haul routes away from receptors. A long paved road after a wheel or vehicle washer before joining the public highway, where feasible, reduces the trick of trackout off-site. A separate paved parking area for off-site vehicles, such as staff cars, with no access to the working areas, can help prevent track-out of mud onto the public highway.
Planting	Existing woodland/hedgerows along site boundaries should be retained where possible. Advance planting of native trees/hedgerows should be considered.

Table 5. Basic Good Practice Mitigation – Operational Measures

	Description
Management	A DMP must be produced and adhered to. Effective site management practices are critical to demonstrate the willingness of the operator to control dust emissions and provides a mechanism for auditing of site operations. Such management procedures should be outlined within the DMP. Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.
Training	Provide training to the site personnel on dust mitigation. Training should also cover 'emergency preparedness plans' to react quickly in case of any failure of the planned dust mitigation.
Monitoring	Implement an appropriate monitoring scheme. This can range from visual inspections, dust deposition/flux monitoring, to real-time PM_{10} continuous monitoring locations. Where possible commence baseline monitoring at least three months before work commences on-site or, if it is a large site, before work on a phase commences. Undertake daily on-site and off-site inspections, audit the monitoring programme: carry out regular site inspections to monitor compliance with the DMP and adjust the frequency of site inspections according to dust risk (higher frequency in dry and windy conditions)
Communication	Maintain good communication to help alleviate anxieties between the operators and the surrounding communities. Set up regular, accessible liaison arrangements and providing information as freely as possible
Planning of activities	Some activities should ideally be planned only during favourable weather conditions. Where possible, particularly dusty activities should be avoided during extended periods of dry and windy conditions.
Vehicle movements	Site traffic is often the greatest source of dust on minerals sites. Standard good practices for site haulage include: • avoiding abrupt changes in direction • regular clearing, grading and maintenance of haul routes • setting appropriate site speed limits. If practicable, set site-specific and enforceable speed limits (e.g. 10 mph. on unmade routes). Where not practicable, the Quarry Manager should set speed limits according to operating conditions at the time • fitting heavy plant with upswept exhausts and radiator fan shields • evenly loading vehicles to avoid spillages • regular application of water, whether by bowser or by fixed sprays, in dry conditions • use paved roads where practicable, ensure mobile plant has upward directing exhausts and radiator fan shields. It is also important to avoid trackout from off-site transportation: • Clean heavy duty vehicles used to transport minerals before they leave the site using an effective wheel- or vehicle-washer.

<table>
<tr><th></th><th>Description</th></tr>
<tr><td>Soil and overburden handling</td><td>Site stripping and reinstatement operations, and overburden handling activities should be avoided during dry and windy conditions. Soils handling is generally a short-lived seasonal activity and there is considerable flexibility as to its timing. Overburden can usually be worked at higher moisture contents than soils which can reduce the risk of unacceptable dust emissions.

Use of soil scrapers is effective in minimising soil handling where the sites are flat, and permit their use. In case of sites with complex topography, use of bulldozers, loaders and dump trucks may be effective and practical to remove soils.

For all mineral handling it is appropriate to minimise handling and reduce drop heights.</td></tr>
<tr><td>Mineral extraction (including drilling and blasting)</td><td>Blasting may be avoided if appropriate alternatives can be employed, for example modern hydraulic excavators and breakers. Equipment used for abrasive blasting should be fitted with dust extraction systems.</td></tr>
<tr><td>Mineral processing[35] (crushing and screening)</td><td>Wherever practicable, crushing and screening should take place within fully enclosed structures, or where this is not possible (e.g. in the case of mobile plant) mineral processing should take place within a sheltered part of the quarry, away from boundaries with off-site receptors. The following measures are considered to be effective in minimizing dust emissions during the mineral processing process:
• dampen material, for example, wetting down of rock stockpiles prior to crushing operation
• protect equipment (for example, conveyors, process plant) by partial or complete enclosure within housing
• use crushing and screening plant within its design capacity
• maintain good standards of all plant and equipment.</td></tr>
<tr><td>Materials handling</td><td>Enclose transfer points and conveyor discharges where visible dust emissions occur. As a general provision, other potential impacts should be mitigated wherever practicable by:
• installation on an even alignment with no abrupt changes in grade
• return belt cleaners, with arisings collected into a bin or cleaned up
• maintenance of the structures and rollers to minimise spillages
• shrouding of feed hoppers, transfer points and discharges;
• fixed sprays where required
• clearance of any spillages to minimise accumulations of loose dry material around the structures
• minimisation of drop heights at feed hoppers and discharges
• Control and restrict the duration of the site activities where practicable
• Storing material under cover, and protecting material from wind
• screening material to remove dusty fractions prior to external storage
• dampen material using sprays, mists, microfoam or foam;
• spray exposed surfaces with chemical binders (after consultation with the regulatory agencies) and spray exposed surfaces of mounds regularly to maintain surface moisture (unless mound surface has formed a crust after rainfall or is grassed)
• design hopper load systems to ensure a good match with truck size, and enclose fully on all sides
• vegetate exposed surfaces, e.g. overburden mounds, with quick growing plants
• filtration equipment may be used to remove silty wastes from waste slurries, and the resulting ‘moist cake’ can then be disposed while it is wet.</td></tr>
</table>

[35] Note these mitigation measures are specific to crushing and screening; however there may be a need to assess other mineral processes on a minerals site as part of the planning application.

8. Glossary & Terminology

This section aims to provide some definitions to help ensure consistency between the dust impact assessments produced by different organisations.

Annoyance (dust)
Loss of amenity due to dust deposition or visible dust plumes, often related to people making complaints, but not necessarily sufficient to be a legal nuisance. Within this document the term 'disamenity' dust is preferred (see below).

Deposited dust
Dust that is no longer in the air and which has settled out onto a surface. Deposited dust is also sometimes called amenity dust or nuisance dust, with the term nuisance applied in the general sense rather than the specific legal definition (see below).

Disamenity
The government Planning Portal does not define disamenity, but its literal meaning would be "impaired amenity" and from its definition of amenity could be considered to be a negative element or elements that detract from the overall character or enjoyment of an area. The Oxford English Dictionary defines disamenity as "the unpleasant quality or character of something". In relation to the impacts of landfills, Defra has described disamenity as nuisance caused by an activity such as noise, odour, litter, vermin, visual intrusion and associated perceived discomfort[36].

Dust
Solid particles that are suspended in air, or have settled out onto a surface after having been suspended in air. The terms dust and particulate matter (PM) are often used fairly interchangeably, although in some contexts one term tends to be used in preference to the other. In this guidance the term 'dust' has been used to include the particles that give rise to soiling and to human health and ecological effects. Note: this is different to the definition given in British Standard 6069, where dust refers to particles up to 75 µm in diameter.

Dust soiling
The effect of deposited dust upon surfaces, which can lead to annoyance.

Effects
The consequences of the changes in airborne concentrations and/or dust deposition for a receptor. This might manifest itself as disamenity due to soiling, increased morbidity or mortality due to exposure to PM_{10}, or plant dieback due to reduced photosynthesis.

Significant effects
The term 'significant effect' has a specific meaning in EIA regulations. The opposite is an insignificant effect. Professional judgement is necessary to determine whether an effect is significant based on the evidence presented.

EIA
Environmental Impact Assessment, as required by The Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 2011; The Town and Country Planning (Environmental Impact Assessment (Scotland) Regulations 2011; and The Planning (Environmental Impact Assessment) Regulations (Northern Ireland) as may be amended from time to time having regard to the Environmental Impact Assessment Directive (85/337/EEC) (as amended).

ES
Environmental Statement, the document that reports the work undertaken for the EIA.

Fugitive dust
Fugitive emissions are those which are not collected and released under controlled physical conditions, e.g. emitted from a stack. On a mineral site, dust emissions occur as a result of many site activities and are typically fugitive.

HGV
Heavy goods vehicles.

Impacts
The changes in airborne concentrations and/or dust deposition. A scheme can have an 'impact' on airborne dust without having any 'effects', for instance if there are no receptors to experience the impact.

Minerals site
Site where solid minerals are extracted from the ground; excludes oil and gas for the purposes of this document.

Nuisance
The term nuisance dust is often used in a general sense when describing deposited dust annoyance. Within this document the term 'disamenity' dust is preferred (see below), as nuisance dust also has specific meanings in environmental law:

a) Statutory nuisance, as defined in S79(1) of the Environmental Protection Act 1990 (as amended from time to time).

b) Private nuisance, arising from substantial interference with a person's enjoyment and use of his land.

c) Public nuisance, arising from an act or omission that obstructs, damages or inconveniences the rights of the community.

Each of these applying in so far as the nuisance relates to the unacceptable effects of emissions.

It is recognised that a significant loss of amenity may occur at lower levels of emission than would constitute a statutory nuisance.

Note: as nuisance has a specific meaning in environmental law, and to avoid confusion, it is recommended that the term is not used in a more general sense

PM
Particulate matter. PM_{10} is airborne particulate matter with an aerodynamic diameter less than 10 microns (μm); $PM_{2.5}$ is less than 2.5 μm.

Receptor
A location itself, or as a proxy for people, which might be affected by dust emissions during minerals activities. Human receptors include locations where people spend time and property which may be damaged by dust. Ecological receptors are habitats that might be sensitive to dust.

Risk
The likelihood of an adverse event (e.g. dust impact) occurring.

Trackout
The transport of dust and dirt from the mineral site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network. This arises when heavy goods vehicles (HGVs) leave the site with dusty materials, which may then spill onto the road, and/or when HGVs transfer dust and dirt onto the road having travelled over muddy ground on site.

Wind-blown dust
Dust which becomes airborne as a result of increased wind speed alone, i.e. could occur when no activity is carried out on site.

[36] Department of Environment and Rural Affairs, 2003. A study to estimate the disamenity costs of landfill in Great Britain, Final report Cambridge Econometrics in association with EFTEC and WRc, London.

Appendix 1: Recent appeal decisions

A review of recent appeals indicates that for disamenity dust, the decisions have continued to be based on the research publications that had informed earlier guidance. Three decisions that deal extensively with dust are provided below.

Bradley: APP/X1355/A/11/2150277

The Bradley decision (APP/X1355/A/11/2150277 Land Adjacent to the A692, known as Bradley, Near Leadgate, County Durham) of February 2012 states;

"At present, there is no statutory guidance for dust and the most up-to-date advice is delivered by Annex 1 to MPS2; Controlling and Mitigating the Environmental Effects of Mineral Extraction in England (2005)".

It goes on to state;
"...most visible dust (the heavier particles) would have dropped out well short of the residential properties....." (which are situated 285 m from the nearest site operations).

The Bradley decision was subsequently quashed in the High Court for legal reasons not involving the Inspector's consideration of dust. In June 2015 planning permission was granted on appeal. The decision accepts that;

"....approximately 95% of dust particles from mineral workings have a relatively high mass and generally deposit within 100m of the point of release, with the remainder being deposited within 200 – 500 m of source."

Regarding the smaller particles (PM_{10} and $PM_{2.5}$), the 2012 Bradley decision states:

"As for smaller particles, the PM_{10}s and $PM_{2.5}$s, the modelling shows there would be only a marginal increase in concentrations over the baseline level, such that the cumulative concentration would fall well below the thresholds given in Air Quality Objectives."

The 2015 Bradley decision states;
"Following the approach in national guidance, although there would be communities within 1km of the site, the technical evidence to the inquiry shows clearly that PM_{10} levels would remain well below the relevant air quality limits. In such circumstances, PPG recommends that good practice measures should be used. This could be ensured by appropriately worded conditions."

Halton Lea Gate (APP/P2935/A/11/2164056)

The Halton Lea Gate decision (APP/P2935/A/11/2164056 Land Adjacent to Halton Lea Farm, Halton Lea Gate, Brampton, Northumberland) of August 2012, states;

"Larger dust particles greater than 30 um, which may comprise 95% of dust released from the site, would be expected to be deposited within 100 m of the source."

It goes on to say;
"Most nuisance dust can be expected to be deposited within 250 m of where it is generated."

In relation to smaller particles, the Halton Lea Gate decision states:

"PM_{10} concentrations in the locality around Halton Lea Gate would not breach the Air Quality Objectives (AQO) referred to within Technical Guidance. Figure 1.1 of the Technical Guidance[37] indicates that, whereas a likelihood of exceeding AQO could justify refusal of planning permission, in this instance the implementation of good practice measures would accord with the document's site assessment framework."

Field House, off Robin Lane, near West Rainton, County Durham DH5 9RH (APP/X1355/W/14/3001645)

A more recent decision (Janaury 2016), for the Field House open cast coal mine, reiterates the view that PM_{10} should not be an issue for mineral sites. It states:

"I appreciate that local residents are apprehensive about the scheme and its likely health effects. However, a modern coal mining operation, with stringent controls imposed by both planning and pollution regimes, would be unlikely to have any significant adverse impacts on the health of the local population. I do not, therefore, consider that much weight can be given to health fears."

Summary

These decisions continue to endorse the statement that had been made in Paragraph 1A.5 of MPS2 Annex 1: *"Large dust particles (greater than 30 μm), which make up the greatest proportion of dust emitted from minerals workings, will largely deposit within 100 m of sources. Intermediate-sized particles (10-30 μm) are likely to travel up to 200-500 m."*, together with the qualification cited in the ARUP report that *"Under normal meteorological conditions, medium-sized (size range 10-30 μm) will generally travel up to 100-250 m from the source before returning to the surface. Only occasionally, when winds are stronger, will they travel beyond this."*

Regarding the smaller particles (PM_{10} and $PM_{2.5}$), those appeal decisions indicate that the site assessment flowchart in the minerals section of the national PPG should form the basis of an assessment, and decisions about acceptability are based on whether the predicted concentrations are likely to fall below the relevant Air Quality Objective.

[37] The Technical Guidance to the NPPF that was referred to, has now been replaced by the minerals section of the nPPG and Figure 1, the site assessment flow-chart, is now reproduced in paragraph 032 of the latter, and as **Figure 1** of this guidance.

Appendix 2: Distance dust deposition/PM_{10} concentration profiles

Introduction

The following graphs show the fall-off in dust deposition and PM_{10} concentrations with distance from the source on mineral sites. The monitoring data were obtained from members of the IAQM Mineral Guidance Working Group. It must be emphasised that these graphs are generic, have been provided in the absence of robust published data and are not intended to be used in isolation from the source-pathway receptor assessment approach for each distinct site and its receptors.

Dust deposition

The graphs below are a generic illustration of dust deposition rates as a function of distance for a range of granitic quarries in the UK. The dust deposition data were collected monthly using Frisbee dust deposit gauges over a period of several years. The data were derived from monitoring undertaken in the vicinity of a number of quarries, and do not take into consideration individual topographic and directional factors.

Table A2-1
Granitic Quarries: Mean Dust Deposition as a Function of Distance from Quarry Operations

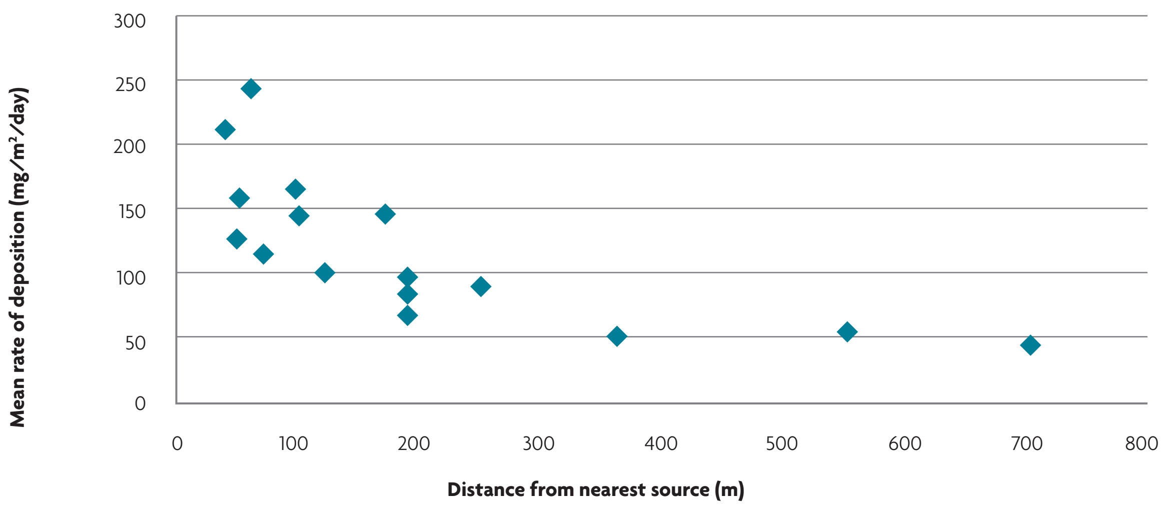
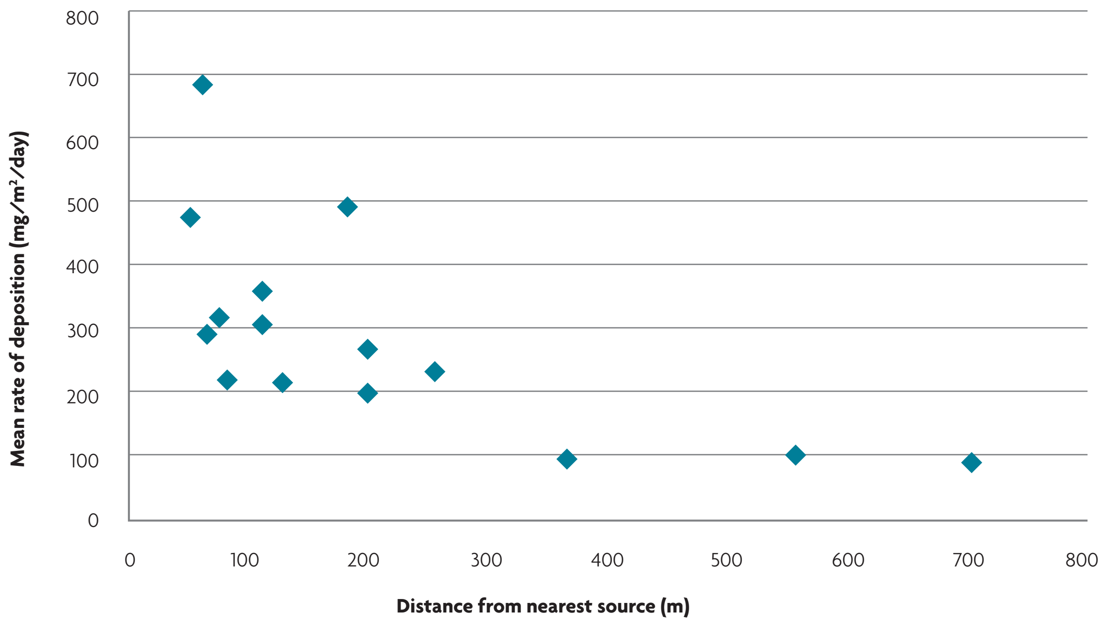
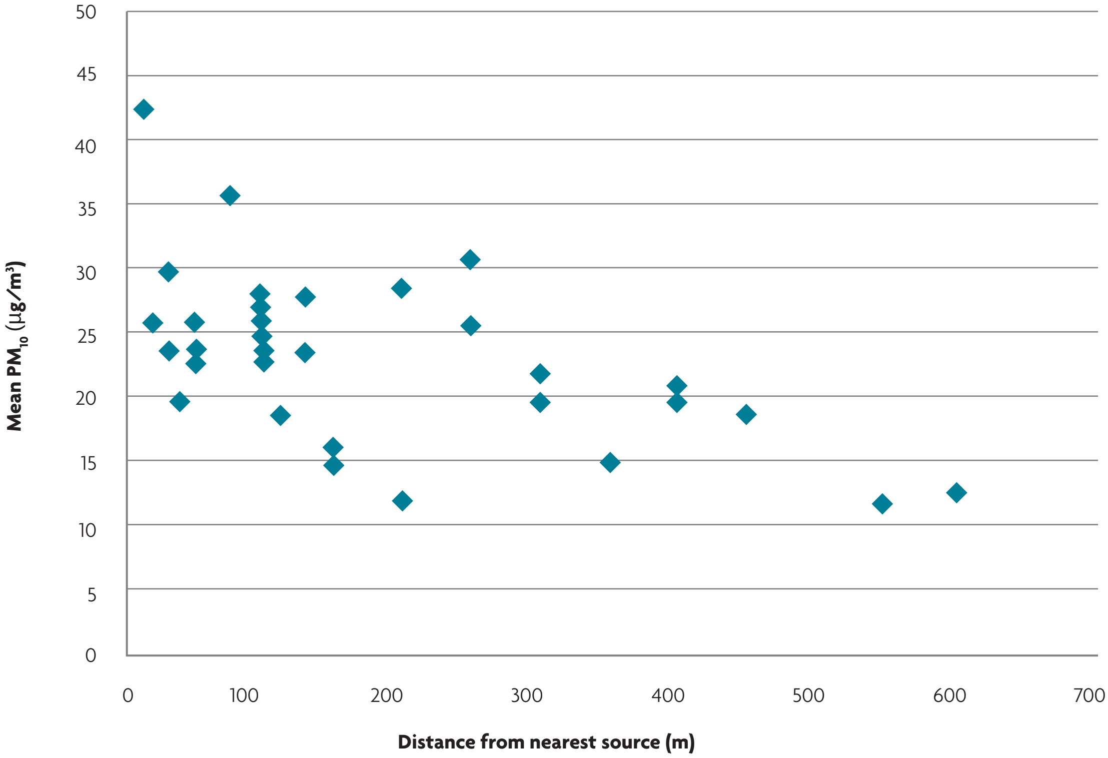


Table A2-2
Granitic Quarries: Maximum Monthly Dust Deposition as a Function of Distance from Quarry Operations



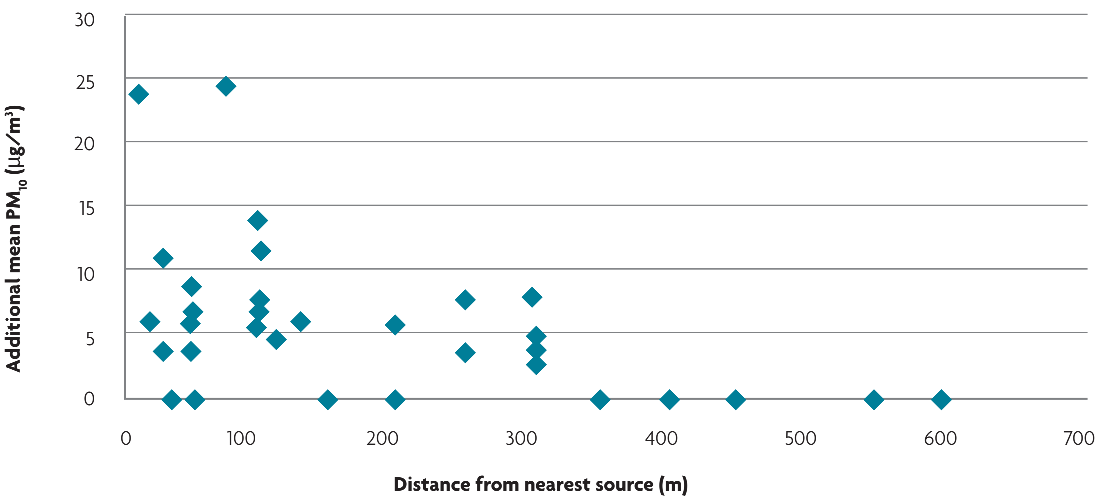
PM_{10} concentrations
The following graph represents gravimetric and equivalent PM_{10} measurements undertaken at a variety of distances from assorted mineral site categories (granitic, sand and gravel, limestone, opencast coal and clay). Each data point represents the PM_{10} values for monitoring periods ranging from 4 months to annual means. These generic values show dispersion of PM_{10} concentrations as a function of distance from nearest potential sources.

Table A2-3
Mean PM_{10} Concentration as a Function of Distance from Quarry Operations (Various Mineral Types)



The following generic values represent the mean additional gravimetric and gravimetric equivalent PM_{10} concentrations above nearest AURN urban/rural background (or other local background monitoring sites) allowing consideration of 'additional' site derived PM_{10} concentrations, as a function of distance from the nearest potential dust generating operations.

Table A2-4
Mineral Site PM_{10} Increment as a Function of Distance from Quarry Operations (Various Mineral Types)



The following graphs show the same PM_{10} data by mineral type.

Table A2-5
Mean PM_{10} Concentration as a Function of Distance from Quarry Operations by Mineral Type

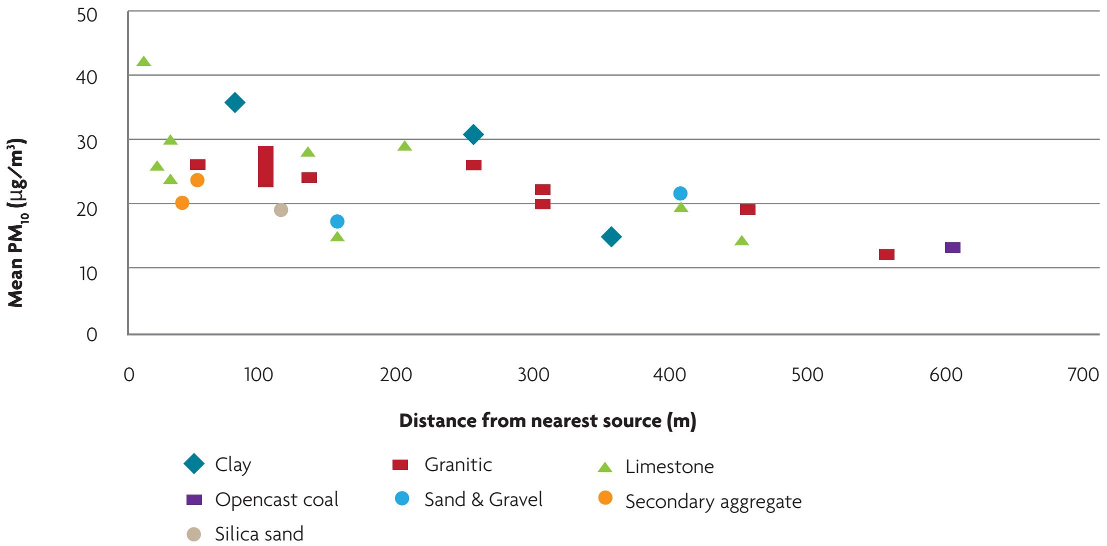
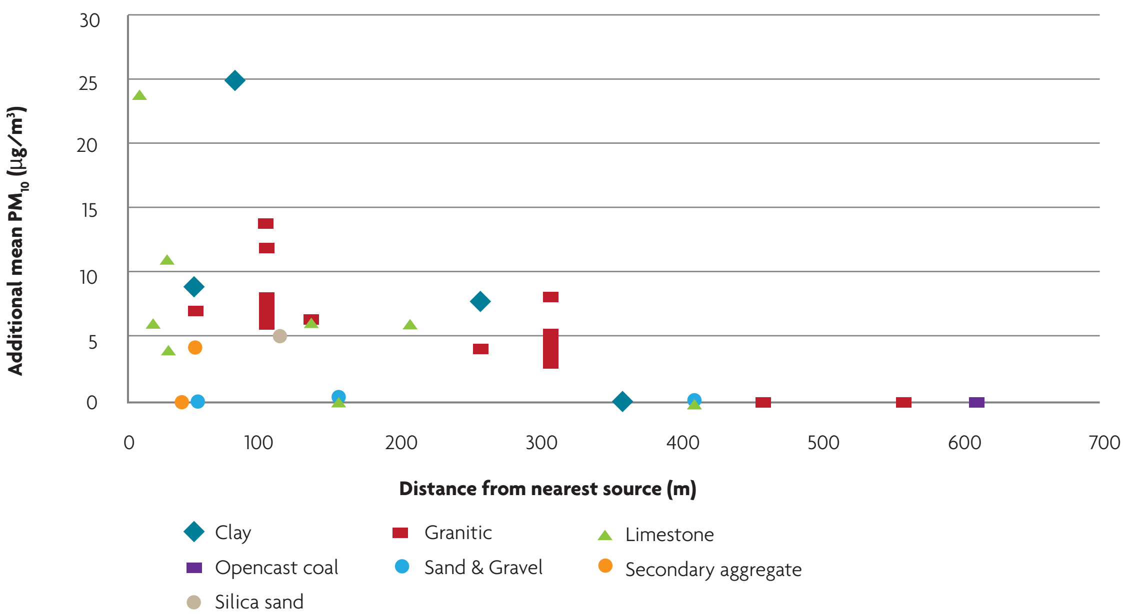


Table A2-6
Mineral Site PM_{10} Increment as a Function of Distance from Quarry Operations by Mineral Type



The next graphs show the same PM_{10} data but by monitoring duration.

Table A2-7
Mean PM_{10} Concentration as a Function of Distance from Quarry Operations for Various Mineral Types by Assessment Periods

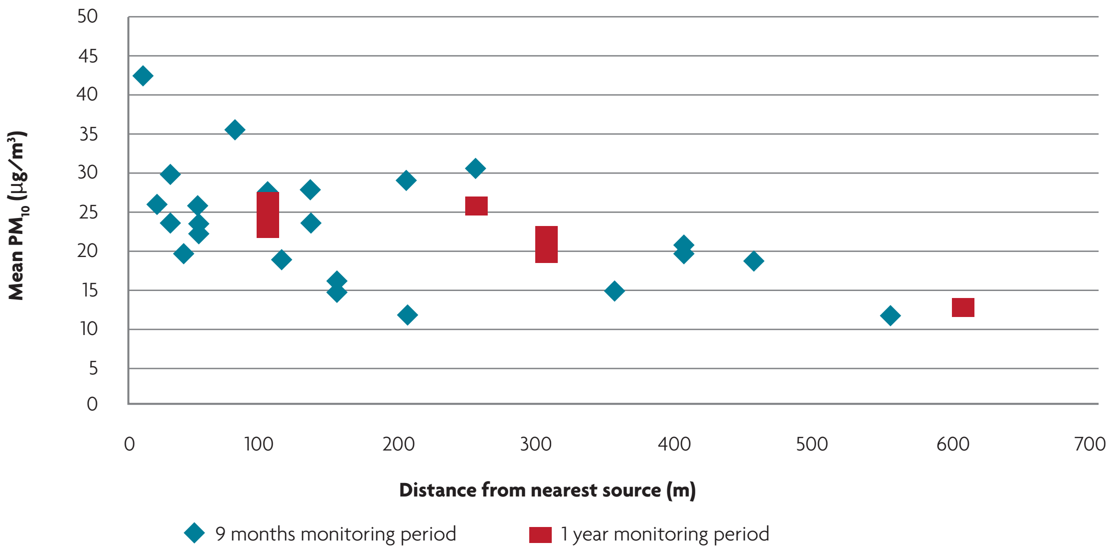
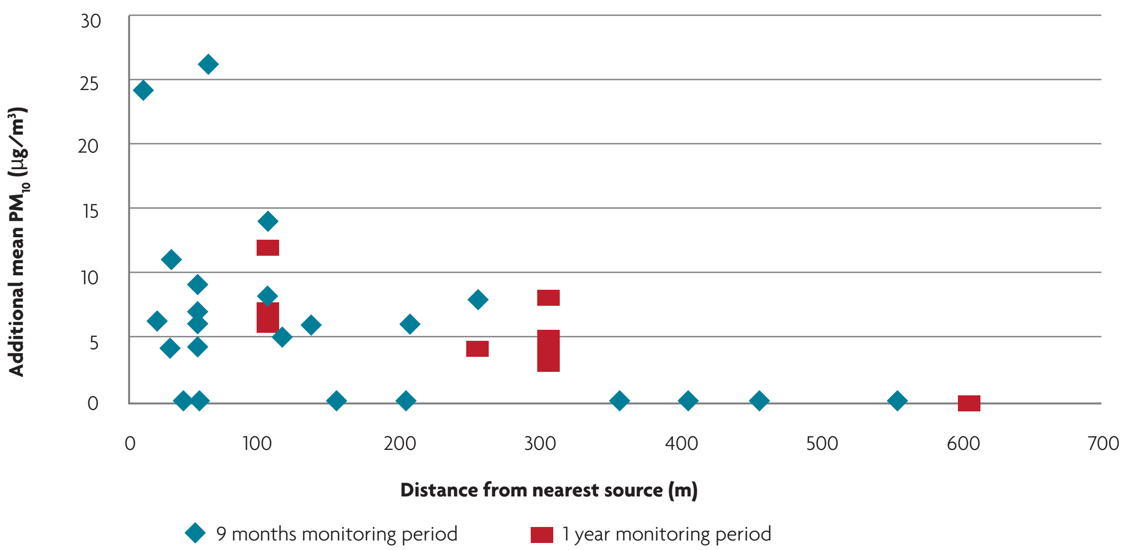


Table A2-8
Mineral Site PM_{10} Increment as a Function of Distance from Quarry Operations for Various Mineral Types by Assessment Period



Appendix 3: Illustrative example procedure for a disamenity dust assessment

This appendix gives an illustrative example of a dust risk assessment for a minerals site based on the underlying IAQM assessment procedure set out in **Section 5.1** of this guidance. Other variants may also be valid provided they follow the underlying IAQM procedure, are based on sound scientific principles and are appropriate for the application.

In reality the assessor would be expected to provide significantly more detail and justification for all conclusions than is provided in this illustrative example.

This illustrative example assumes that 'Step 1 Site Characteristics and Baseline Conditions' (from the underlying IAQM assessment procedure set out in **Section 5.1** of this guidance) has already been undertaken, and starts with Step 2. It provides a series of assessment matrices which are used to estimate the Dust Impact Risk, the Pathway Effectiveness and the Likely Magnitude of Disamenity Effects at each receptor. The latter is used to determine whether overall there is likely to be a significant effect or not on the surrounding area.

Step 2: Estimation of Dust Impact Risk

Estimation of Residual Source Emissions

The Dust Impact Risk was determined for each of the main operational activities:

a. Site preparation and restoration;
b. Mineral extraction;
c. Materials handling;
d. On-site transportation;
e. Mineral processing;
f. Stockpiles and other exposed surfaces;
g. Off-site transportation (track-out).

More than one of these activities may occur on the site at any one time, and this was taken into consideration in the assessment.

Owing to the long-term nature of this minerals development, the site was divided into 'zones' for the dust risk assessment. Such zones were considered in relation to:

- Phasing, as essentially the same processes will take place sequentially over the site during the period 2017 to 2030, and
- activity, as crushing and screening, will take place at the same area of the site for the duration of operations.

Different mitigation levels were applied to each zone.

The Residual Source Emissions was based on the scale of the anticipated operations and was classified as Small, Medium, or Large for each relevant operational activity for each zone, taking into account the designed-in mitigation. The Residual Source Emissions for each activity in this example are summarised in **Table A3-1**.

Table A3-1. Example Residual Source Emissions Classification for Phase 1

Activity	Residual Source Emissions
Site Preparation and Restoration	Small
Mineral Extraction	Medium
Materials Handling	Medium
On-site transportation	Large
Mineral Processing	Large
Stockpiles and Exposed Surfaces	Medium
Off-site transportation	Small

Estimation of Pathway Effectiveness
The site-specific factors considered to determine the Effectiveness of the Pathway were the distance and direction of receptors relative to the prevailing wind directions. There are few receptors within 400 m of the site and therefore each receptor was considered separately. The site is reasonably flat and no bunds or planting are proposed on the boundary of the site that may impact on the dispersion of dust.

For each receptor within 400 m on the site boundary the wind directions for each source were calculated. The frequencies of wind in each direction were then calculated based on meteorological data for five years from a nearby representative meteorological station.

The resulting frequency of moderate to high wind speeds with the potential of carrying airborne dust towards receptors were then assigned to the categories in **Table A3-2** based on 12 x 30° wind direction sectors.

Table A3-2. Categorisation of Frequency of Potentially Dusty Winds

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%

In this illustrative example, the categorisation shown in **Table A3-3**. was applied to the distance from each receptor to source.

Table A3-3. Categorisation of Receptor Distance from Source

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

The pathway effectiveness was classified using the Frequency of Potentially Dusty Winds from **Table A3-2** and the Receptor Distance from Source from **Table A3-3**, as shown in **Table A3-4**.

Table A3-4. Pathway Effectiveness

		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

Estimation of Dust Impact Risk
The Residual Source Emissions and the Pathway effectiveness were combined to predict the Dust Impact Risk as shown in **Table A3-5**.

Table A3-5. Estimation of Dust Impact Risk

		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

Step 3: Estimate Likely Magnitude of Disamenity Effects

There are no designated sites near the mineral site and therefore the potential effect on impacts on ecology was not considered.

The likely disamenity effect at each receptor was determined from the Dust Impact Risk (**Table A3-5**) and the Receptor Sensitivity (see **Box 3** in **Section 6**) as shown in **Table A3-6**.

Table A3-6. Descriptors for magnitude of dust effects

		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

The dust disamenity effects predicted at each receptor around the minerals development was summarised in a table setting out the risks of impacts for each zone/activity being assessed; as illustrated in the example in **Table A3-7**.

Table A3-7. Example of Summary of Dust Disamenity Effects at Specific Receptors

Ref	Receptor details and location	Location relative to nearest dust source	Residual Source Emissions	Pathway Effectiveness	Dust Impact Risk	Receptor Sensitivity	Magnitude of Dust Effect
R1	Rock House Green Lane (Residential)	220 m "downwind" of mineral extraction	Medium	Moderately Effective	Low Risk	High	**Slight Adverse Effect**
R2	Wood Cottage Kings Road (Residential)	300 m "upwind" of haul road	Large	Ineffective	Low Risk	High	**Slight Adverse Effect**
R3	Village Store and Post Office (Commercial/ Retail)	170 m "downwind" of mineral processing	Large	Moderately Effective	Medium Risk	Medium	**Slight Adverse Effect**
R4	The Rec (Playing Fields)	150 m "upwind" of stockpiles	Medium	Moderately Effective	Low Risk	Low	**Negligible Effect**
R5	Public footpath	50 m "downwind" of mineral processing	Large	Highly Effective	High Risk	Low	**Slight Adverse Effect**

Overall, the proposed development is considered to have a slight adverse effect on the surrounding area. This effect is considered to be 'not significant'. This is based on a consideration of the different magnitude of effects at individual receptors, and the number of receptors that would experience these different effects. The designed-in mitigation measures together with the operational measures detailed in the site Dust Management Plan are considered to be appropriate to mitigate the potential impacts.

Appendix 4: Determining residual source emissions

Examples are given below of the residual source emissions magnitude for a number of activities, illustrating the factors that may be considered when making a professional judgement. Examples are based on the experience of the Working Group from data provided by the minerals sector, but are not prescriptive.

When undertaking the assessment the designed-in mitigation measures, such as the location of particular activities on the site and the landscaping at the site boundary, need to be taken into account.

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

An example of a large potential dust magnitude from site preparation/restoration may include factors such as a working area >10ha, bunds >8 m in height, >100,000 m^3 material movement, >10 heavy plant simultaneously active, bunds un-seeded, fine grained and friable material. Conversely, a small potential dust magnitude may include a site with a working area <2.5ha, bunds <4 m in height, <20,000 m^3 material movement, <5 heavy plant simultaneously active, all bunds seeded, material with a high moisture content.

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

An example of a large potential dust magnitude from mineral extraction may include a working area >100 ha, drilling and blasting frequently used, dusty mineral of small particle size and/or low moisture content, 1,000,000 tpa extraction rate. A small potential magnitude may include working area <20 ha, hydraulic excavator, coarse material and/or high moisture content, <200,000 tpa 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

An example of a large potential dust magnitude from materials handling may include factors such as >10 loading plant within 50 m of a site boundary, transferring material of a high dust potential and/or low moisture content on dry, poorly surfaced ground. Conversely, a small potential dust magnitude may include <5 plant, more than 100 m of a site boundary, within the quarry void or clean hardstanding, transferring material of low dust potential and/or high moisture content.

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

An example of a large potential dust magnitude from on-site transportation could include >250 movements in any one day on unpaved surfaces of potentially dusty material. A small potential magnitude may include the employment of covered conveyors used for the majority of the on-site transportation of material, <100 movements of vehicles per day, with surface materials of compacted aggregate, <500 m in length and a maximum speed of 15 mph.

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

An example of a large potential dust magnitude from mineral processing may include factors such as a mobile crusher and screener with concrete batching plant on-site, processing >1,000,000 tpa of material with a high dust potential and/or low moisture content e.g. hard rock. Conversely, a small potential dust magnitude may include a site with a fixed screening plant with effective design in dust control, processing <200,000 tpa of material with a low dust potential and/or high moisture content e.g. wet sand and gravel.

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

An example of a large potential dust magnitude from stockpiles and exposed surfaces could include a stockpile with a total exposed area ›10 ha in an area exposed to high wind speeds located ‹50 m of the site boundary. Daily transfer of material with a high dust potential and/or low moisture content. Stockpile duration ›12 months and quarry production ›1,000,000 tpa. A small potential magnitude may include stockpile duration of ‹1 month with a total area ‹2.5 ha in an area of low wind speeds, located ›100 m from the site boundary. Weekly transfers of material with a low dust potential and/or high moisture content. Quarry production ‹200,000 tpa.

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

An example of a large potential dust magnitude from off-site transportation could include total HDV ›200 movements in any one day on unsurfaced site access road ‹20 m in length with no HDV cleaning facilities. No road sweeper available. A small potential magnitude may include ‹25 HDV movements per day, paved surfaced site access road ›50 m in length, with effective HDV cleaning facilities and procedures, the employment of an effective road sweeper.

Appendix 5: Sources of information for PM_{10} process contributions

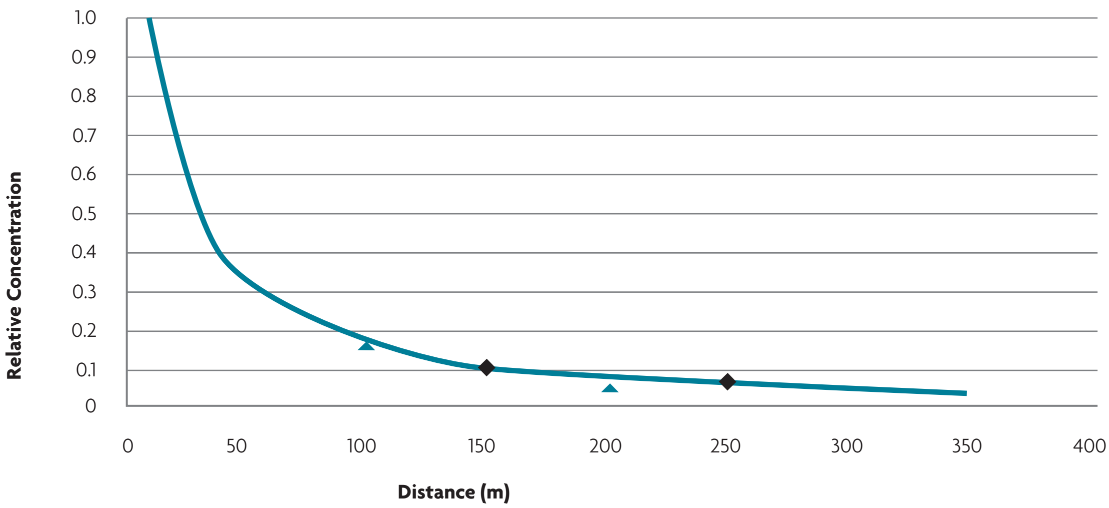
The IAQM recommended dust assessment for PM_{10} estimates the total predicted environmental contribution (PEC) by adding the process contribution (PC) to the background PM_{10} contribution.

There has been limited data available on which to base likely PCs from minerals operations. Some information is provided in the tables, text and nomographs in older guidance (LAQM technical guidance TG(03)); however more up-to-date minerals-specific data would be preferred and the IAQM has collated the recent data of which it is aware and summarised this in **Table A5-1** below.

Table A5-1. Summary of likely PM_{10} Process Contribution

Source	Process Contribution PM_{10}	Comments
LAQM.TG(03)	Concentration = ((350 µg/m³ Defra background)/26)* (27.975*Distance$^{-1.11}$) Graphical Plot shown below in **Figure A5-1**	Uses worst case PC at source of 350 µg/m³ and distance from source Receptor assumed to be downwind of source, with a 5 m/s wind and no dust mitigation in place For assessment of short term (24-hour) air quality objective
	Variable, up to 5	Annual mean background
Newcastle Study	2 µg/m³	Average daily background levels at opencast coal sites compared to control sites
COMEAP (2002)	+14% factor	Worst case annual background

Figure A5-1 Calculation of PM_{10} Concentration with distance from Source (LAQM.TG(03))



Also shown are data points from PM_{10} Survey Around 'Worst Case" Coal Handling Plant. The data points were normalised to fit on the line at teh nearest point to the source

Appendix 6: Recommended content of Dust Management Plans (DMPs) for minerals planning applications

Where there is potential for local receptors to be impacted by dust from a minerals development, a Dust Management Plan (DMP) may be required in support of the application or to discharge a condition attached to the planning consent. This appendix summarises the IAQM`s recommended content for a DMP.

Aims and Objectives of a Dust Management Plan

A DMP is a documented site-specific operational plan to prevent or minimise the release of dust from the site. It should describe the management and operational actions the site will use to deal with both anticipated (e.g. forecast) and actual high risk conditions (e.g. dry days with measured winds above moderate breeze). The DMP should describe the conditions under which dust is most likely to pose a risk of disamenity at sensitive receptors close to the site and set trigger levels which, when exceeded, would require further dust control measures to be implemented (i.e. over and above the routine measures). The nPPG provides little detailed guidance on identifying dust-sensitive receptors; therefore the IAQM recommends that practitioners use the receptor-sensitivity definitions in this guidance (**Boxes 3**, **4** and **5**). Examples of sensitive receptors include homes, schools, hospitals, car parks/showrooms, places of work and footpaths.

Dry windy days have the highest risk of causing disamenity and the predecessor to the Minerals section of the nPPG, former minerals planning guidance MPS2, specifically described the setting of trigger levels for wind speed, wind direction and proximity to sensitive receptors, and also stated that the pattern of rainfall is important (e.g. periods of dry weather). The IAQM endorses this approach.

The further dust controls that are brought in when the triggers are exceeded must be checked to ensure they have been effective; if necessary, the level of additional control must be escalated or site operations modified or temporarily suspended to prevent dust disamenity.

Expected Content of Dust Management Plans

The air quality section of the nPPG advises that *"Mitigation options where necessary will be locationally specific, will depend on the proposed development and should be proportionate to the likely impact."* In accordance with that guidance, the IAQM expects the appropriate dust management and mitigation measures to vary from site to site depending on the dust sources on site; the location and proximity of sensitive receptors and their sensitivity to dusts; and the weather conditions. The DMP should be risk-based, with the level of depth, complexity and sophistication of the DMP being dependent on the complexity of the processes and the potential impact from release of dust on neighbouring premises: where a process has a high potential for dust impacts, then the DMP will necessarily be detailed and thorough; conversely, for a process with a lower potential dust impact, a simpler DMP will suffice.

The following, drawn from MPS2 together with other good practice guidance, summarises the essential components of a DMP:

i. A process description, particularly describing dusty, or potentially dusty, activities or materials used, and materials handling, storage and use of equipment, etc.

ii. Identification of all the significant dust release points for each of the activities or materials and their locations (with reference to a map/plan if possible).

iii. Identification of the sensitive receptors within the area of influence that could be impacted (with reference to a map/plan if possible).

iv. A description of the <u>routine</u> mitigation/control measures that would be used day-to-day under normal operating conditions in the absence of any unusual risk factors, together with information on how the minerals operator (either directly or through its contractors or subcontractors) will ensure that any dust control equipment is designed, operated and maintained such that it operates effectively to control dust.

v. A description of the <u>additional</u> measures that will be applied during these periods to manage dust emissions should actual or forecast trigger levels be exceeded, other risk factors occur, or should routine visual observations show high dust emissions. You should describe additional control measures and modifications to site operations and procedures, who specifically is responsible for carrying them out, and how the minerals operator will reduce or cease operations, if necessary, to avoid serious dust pollution.

vi. A description of what would trigger the further action/additional measures, such as:

a) the high-risk weather conditions under which dust is most likely to pose a disamenity risk and the particular trigger levels (e.g. for wind above a certain speed, wind blowing in a particular direction, number of dry days and proximity to residential properties) which, when exceeded, would require further control measures to be implemented. For example, dry windy days have the highest risk of causing a disamenity risk at sensitive receptors (e.g. homes, schools and hospitals) close to the site and downwind of the site. A description is required of how the minerals operator will estimate or monitor actual high-risk conditions (e.g. dry dusty winds above moderate breeze), and anticipate (e.g. forecast) the onset of imminent high-risk conditions, under which dust is most likely to pose a disamenity risk;

b) the results of planned routine checks/inspections/surveys on site, e.g. visual inspections;

c) dust monitoring on and/or off-site, including dust complaints monitoring together with any emission limit values (ELVs) for source releases, or action levels for measured ambient dust levels, and

d) any other possible risk factors (e.g. equipment/control failures, abnormal/unintentional situations, spillages, etc.).

vii. Specify procedures to check these further dust controls have been effective and, if necessary, escalate the level of additional control or modify or temporarily suspend site operations to prevent dust disamenity.

viii. Procedures, to investigate and take appropriate action to prevent recurrence on receipt of complaints of dust disamenity or on any elevated dust levels being present from the aforementioned checks/inspections/surveys or monitoring.

ix. Management procedures describing the roles and responsibilities of personnel on site, staff training and competence, planned maintenance and repair, keeping of essential dust-critical spares, regular review of the effectiveness of dust controls (including reviewing and updating the DMP itself to ensure it is refined on the basis of observations and experience), record keeping, etc.

x. How the minerals operator will respond to and communicate with relevant interested parties (e.g. local community and local authority) to provide necessary information and minimise their concerns and complaints, including methods used, content and frequency of communication.

Though the style of the submitted document is a matter for the air quality practitioner and the applicant, a DMP document that includes the above components (to a level of depth, complexity and sophistication that is commensurate with the complexity of the minerals or waste processes and the potential dust impact) should, in the IAQM's opinion, be suitable for most minerals planning applications or conditions. This is, however, subject to an important caveat: as practitioners will be keenly aware, a DMP is merely a wrapper document for the management procedures and mitigation/control measures it contains; the DMP will only be of benefit if the underlying mitigation and control measures are effective and practitioners (together with applicants) should ensure these are sufficiently robust.

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