



Ministry for the
Environment
Manatū Mō Te Taiao

Good Practice Guide for Assessing and Managing Dust

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1 Introduction

1.1 Purpose of this good practice guide

This good practice guide provides useful information and recommendations for councils, communities and industry on how to assess and manage dust (non-combustion particulate matter) emissions from fugitive sources¹ such as quarrying, aggregate crushing, abrasive blasting, sealed and unsealed surfaces, and material stockpiles.

Particulate matter contains all solid and liquid particles suspended in the air. This guide focusses on dust particles greater than 10 microns due to its localised, nuisance effect when deposited, rather than its contribution to a wider ambient issue. Due to its greater diameter and density, deposited dust can impact on land-use activities and amenity values, such as soiling of buildings, as well as cause visual impacts.

While this guide focusses on nuisance effects, it acknowledges that fugitive dust generated by activities such as construction, roading, and excavation projects can include smaller particles of 10 microns and below. These can stay suspended in the atmosphere for significant periods and can fall within the respirable range, causing adverse health effects. This smaller fraction of particulate matter includes particles 10 micrometres in diameter (PM₁₀ known as ‘coarse particles’) and 2.5 micrometres in diameter (PM_{2.5} known as ‘fine particles’).

This guide provides information on:

- how to assess and manage environmental effects of dust emissions
- sources of dust emissions
- potential health effects and environmental effects associated with dust emissions
- who is responsible for managing dust, based on current legislation and air quality / assessment criteria
- methods available to assess the environmental effects of dust emissions
- how to monitor the effects of dust through surveys, complaints monitoring, and environmental monitoring and how to use these methods for dust assessments
- how to undertake dust investigations in response to complaints
- when to use dispersion modelling
- methods and options for managing and controlling dust emissions
- recent case studies and worked examples illustrating how to manage dust.

This guide updates the Ministry for the Environment’s previous *Good Practice Guide for Assessing and Managing the Environmental Effects of Dust Emissions* (Ministry for the Environment, 2001a). The update expands on previous guidance (which focussed only on ‘nuisance’ effects of dust), to incorporate health effects from fugitive dust emissions. Due to the potential impact on human health, PM₁₀ is managed under the Resource Management

¹ Fugitive dust is from sources that are not stacks ie, diffuse sources – for example dust blown from storage piles, road dust, dust leaking from a building.

(National Environmental Standards for Air Quality) Regulations 2004 (the NES for air quality) and Ambient Air Quality Guidelines².

The recommendations in this guide provide a practical and reasonable approach to managing dust. This guide is one of a series of good practice guides for air quality developed by the Ministry for the Environment. For a full list of these guides see: www.mfe.govt.nz/air/improving-air-quality/good-practice-guides-councils.

There is a strong relationship between the guides. For example, if an assessment requires an assessment of the effects of odour, this guide will refer you to the *Good Practice Guide for Assessing and Managing Odour* (Ministry for the Environment, 2015b). Taken together, the good practice guide series will help provide for comprehensive and consistent management of air quality in New Zealand.

Because this guide covers assessment and management of all sources of dust in New Zealand, it is somewhat generic. If you require industry-specific guidance for dust emissions (eg, cement manufacture plants) refer to:

- (Australia) **NSW EPA Local Government air quality toolkit** – Part 3: air quality guidance notes for specific activities or operations, at www.epa.nsw.gov.au/air/aqt.htm
- **European Integrated Pollution Prevention and Control Bureau (EIPPCB)** – best available techniques reference documents (BREFs) for a wide range of industrial sectors, at <http://eippcb.jrc.ec.europa.eu/reference>
- (UK) **Department for Environment, Food & Rural Affairs (Defra)** extensive range of process guidance notes for specific industries, at www.gov.uk/government/collections/defra-guidance-on-local-authority-pollution-control-lapc-regime.

These guides, however, are not specific to New Zealand, and do not take precedence over guidance in this document.

This guide does not cover occupational health issues for workers involved in dusty activities. The WorkSafe New Zealand division of the Ministry of Business, Innovation and Employment has relevant legislation and specific guidance information to deal with these issues.³

The following key issues associated with dust management will be addressed by this guide:

- **Subjective effects.** Assessing the environmental effects of dust can be difficult because of the subjective nature of the effects. People may be annoyed by dust fallout on their property, and some may find it objectionable or offensive. A number of practical and legal aspects need to be considered in judging the severity and significance of these effects.
- **Assessment methods.** Many dust emissions come from diffuse sources, such as bare ground, unsealed roads, mines and quarries. As a result, it is difficult to quantify the emissions and to accurately predict the likely effects.

² Guidance on implementation of these regulations can be found in the *2011 User's Guide to the revised National Environmental Standards for Air Quality*. Monitoring under the NES for air quality must comply with the methods prescribed in Schedule 2 of the regulations. Additionally, dust site selection for pollutants managed under these regulations must comply with the AS/NZS 3580.1.1:2007 *Methods for sampling and analysis of ambient air – Guide to siting air monitoring equipment standard*.

³ See www.business.govt.nz/worksafe.

- Variability of the receiving environment. Measurable amounts of dust can be found in most urban and rural environments, but the levels can be highly variable. There are also extreme situations, such as drought-stricken rural areas or fallout from volcanic eruptions, where the natural dust levels can be well above the recognised nuisance levels.
- Land-use planning. Dust nuisance problems are often associated with land-use activities. This raises the issue of overlapping responsibilities between territorial local authorities and regional councils. There is also a need to recognise and provide ways to minimise the potential impacts of dust nuisance through land-use planning.
- Understanding cumulative effects. In some areas there may already be relatively high background levels of dust and dust deposition. It is important to determine how these should be taken into account when carrying out an environmental assessment.
- Potential health effects and how these should be addressed in an assessment of the impacts.

1.2 Target audience

This guide is primarily aimed at practitioners making assessments of non-combustion dust effects. These are mainly council officers and consultants. The guide will also be of interest to other stakeholders such as planners and resource managers, lawyers, business, industry and the general public.

Dust can affect anyone; and often the people trying to prevent dust effects from occurring are construction and roading contractors, or industrial site managers. With this additional audience in mind, some sections include 'hands on' practical information and tools that can be tailored to particular situations and communities. The intent is to provide a consistent approach to managing dust effects across the country.

1.3 Legislative context

The recommendations in this guide are not legislative requirements under the Resource Management Act 1991 (RMA) or any other legislation. However, they are based on expert advice and consultation with practitioners involved in dust assessment, and regulators charged with managing dust effects. As such they should be taken into account in decision-making processes.

1.3.1 Roles and responsibilities

Under the RMA, the primary responsibility for managing air quality lies with regional councils and unitary authorities. Regional councils also have responsibilities under the NES for air quality.

A unitary authority is a territorial authority that also has all the responsibility of a regional authority – unifying both roles in one local government body which covers one geographical area.

Territorial authorities do not have a specific air quality management function under the RMA. Territorial authorities do however have the primary responsibility for land use, which includes the location of activities that may discharge dust, such as:

- activities involving agrichemical application

- industry
- intensive farming
- transport infrastructure (roads, ports, airports).

District councils also have primary responsibility for managing the location of activities that are sensitive to discharges to air (eg, residential zones). Through managing land use therefore, district plan provisions manage the air quality effects of activities on sensitive land uses.

People with activities that discharge to air (dischargers) must comply with the requirements of:

- the RMA, including section 17 (general duty to avoid, remedy or mitigate adverse effects)
- the NES for air quality
- any relevant regional plan
- resource consent conditions.

1.3.2 Resource Management Act 1991

The purpose of the RMA as specified in section 5(1) is “to promote the sustainable management of natural and physical resources”. Section 5(2)(c) provides for “avoiding, remedying, or mitigating any adverse effects of activities on the environment”.

‘Effect’ is defined in section 3 of the RMA as including:

- (a) any positive or adverse effect; and
- (b) any temporary or permanent effects; and
- (c) any past, present, or future effect; and
- (d) any cumulative effect which arises over time or in combination with other effects—
regardless of the scale, intensity, duration or frequency of the effect, and also includes—
- (e) any potential effect of high probability; and
- (f) any potential effect of low probability which has a high potential impact.

Section 2 of the Act defines “environment” as including:

- (a) Ecosystems and their constituent parts, including people and communities; and
- (b) All natural and physical resources; and
- (c) Amenity values; and
- (d) The social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs (a) to (c) of this definition or which are affected by those matters.

The term “amenity values” is also defined in section 2 of the RMA, as:

those natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes.

Section 9

Section 9 of the RMA allows a person to use land in any manner they like, provided it does not contravene a rule in a plan. If the activity does contravene a rule, then a resource consent is required, (unless existing use rights already apply). Dust emissions from a land use may, therefore, be controlled if the plan includes restrictions on the effects of the use of land that causes the dust emission, and/or amenity requirements.

Section 15

The compounds that cause dust effects are air contaminants, so their discharge is controlled under section 15 of the RMA. Under section 15(1), discharges from industrial or trade premises are only allowed if they are authorised by a rule in a regional plan, a resource consent, or regulations (such as a national environmental standard). If the activity is prohibited under the plan, then no resource consent can be obtained.

Under sections 15(2) and 15(2A), the opposite presumption applies to discharges from any other source. Unless these sources are controlled by a national environmental standard or a rule in a plan, discharges are allowed as of right and consent is not required.

In essence, if there are discharges of dust to air from an industrial or trade premises, the discharge will need to be either:

- a permitted activity in a regulation or plan, or
- authorised by a resource consent.

If the discharges of dust to air are not from an industrial or trade premises then, unless there is a rule or regulation relating to the discharge, a consent is not needed.

Section 17

Section 17 of the Act imposes a general duty on every person to avoid, remedy or mitigate any adverse effect on the environment arising from any activities the individual may conduct or have carried out on their behalf. This applies regardless of whether the activity is carried out in accordance with any rule, plan or resource consent.

Section 17(3)(a) allows an enforcement order to be made or served under sections 314(1)(a)(ii) or 322(1)(a)(ii). These require a person to cease doing something that is, or is likely to be, noxious, dangerous, offensive or objectionable to such an extent that it has or is likely to have an adverse effect on the environment.

Any person may apply for an enforcement order.

Section 88 (and Schedule 4)

The RMA specifies information requirements for resource consent applications under section 88 and Schedule 4. These provisions were amended in 2013, and the new provisions came into effect on 3 March 2015. If you are applying for resource consent you should refer to the [Good Practice Guide for Assessing Discharges to Air from Industry](#) (Ministry for the Environment, 2015a) for further information.

Enforcement

Under the RMA, the following enforcement tools may be used:

- infringement notice (issued by council)
- abatement notice (issued by council)
- enforcement order (issued by the Environment Court)
- interim enforcement order (issued by the Environment Court)
- prosecution.

Any person may apply for an enforcement order or take a prosecution. See the [An Everyday Guide to the RMA: Enforcement](#) (Ministry for the Environment, 2015) for information on these enforcement mechanisms.

1.3.3 National environmental standards

National environmental standards (NES) under the RMA are regulations that can prescribe technical standards, methods, or requirements. These regulations are implemented by regional councils (eg, for air) and district councils (eg, for soil).

In 2004, the Government introduced the Resource Management (National Environmental Standards for Air Quality) Regulations 2004 (the NES for air quality) to set a guaranteed minimum level of health protection for all New Zealanders.

Detail of the standards within the NES for air quality can be found on the [New Zealand legislation website](#). It is important to note that Regulation 28 of the NES for air quality enables certain regional rules, resource consents, and bylaws to be more stringent than these regulations. Therefore, you should consult the relevant regional plan(s) for full details of the rules and regulations in an area. Specifically, the regulations include an ambient air quality standard for PM₁₀, and the requirements for regional councils to manage airsheds to meet this standard. While this guide focusses on dust particles greater than 10 microns due to its localised, nuisance effect when deposited, some dust contains PM₁₀. Therefore, the effects of any dusty activity must be considered in relation to the NES for air quality.

Further information on the national environmental standards for air quality, including in relation to PM₁₀ can be found in the:

- [2011 Users' Guide to the Revised National Environmental Standards for Air Quality: Updated 2014](#) (Ministry for the Environment, 2014)
- [Clean Healthy Air for All New Zealanders: The National Air Quality Compliance Strategy](#) (Ministry for the Environment, 2011).

It is important to note that Regulation 28 of the national environmental standards for air quality specifically provides that a rule, resource consent, or bylaw that is more stringent than the regulations, prevails over the regulations.

1.3.4 National policy statements

There is no national policy statement on air quality.

The 2010 New Zealand Coastal Policy Statement (NZCPS) gives effect to the RMA in the coastal marine area. It focuses on discharges to water and coastal areas, but does not explicitly address air quality matters. It should be noted, however, that:

- policy 4 requires coordinated management or control of activities within the coastal environment, and which could cross administrative boundaries (eg, discharges to air in Nelson/Tasman regions)
- policy 11 protects indigenous biological diversity (in the event that any discharge to air may cause adverse effects to indigenous biological diversity)
- the NZCPS has to be taken into account in consideration for an application for a coastal permit for a discharge to air located in the coastal management area.

Typically air quality assessments focus on human health-related matters. The NZCPS may be relevant, however, for emissions of toxic contaminants or dusts in the coastal marine area.

1.3.4 Regional policy statements

Regional policy statements provide an overview of air quality and other environmental issues in a region. They further specify policies and methods to achieve integrated management of air quality, and other natural and physical resources, in each region.

1.3.5 Regional plans

Regional plans specify objectives and policies, and the methods that will be used to manage air quality within a region. These plans may be specific to air quality (eg, a regional air quality management plan) or cover all resources in the region. Regional plans must give effect to the provisions of the regional policy statement, national policy statements, national environmental standards and the RMA.

Regional plans for air quality management generally include objectives and policies for managing ambient air quality, as well as localised effects for example, dust and odour.

Under section 68 of the RMA, councils can use rules to allow, regulate or prohibit activities. Individual sources or groups of sources are typically controlled by rules in plans that specify whether the activities are permitted (typically with conditions), controlled, restricted discretionary, discretionary, non-complying, or prohibited.

Regional air plans generally provide for permitting activities with a low potential for adverse effects, provided certain conditions are met. In some cases the activity may be known to be odorous or dusty, but is deemed acceptable (and classified as a permitted activity) based on its location (eg, field ploughing).

The plans may also include policies and methods for managing identified issues such as dust nuisance, odour, smoke from domestic fires, and motor vehicle emissions. In addition to rules, non-regulatory mechanisms may be adopted, such as education and development of industry codes of practice.

Regional air quality management plans are developed through a process of public consultation and review, before the plan becomes 'operative'. Check the current status of specific plans with the relevant regional council, as there may be more than one plan that needs to be considered.

1.3.6 Unitary and district plans

Under section 31 of the RMA, territorial authorities have responsibilities to control land use, and to achieve integrated management of the use, development or protection of land and associated natural and physical resources of the district. This includes effects of land use on air quality and on amenity values.

District rules specify the type of activities, including industries that are allowed in different areas or zones. In assigning zones to particular areas and developing zone provisions, district plans should consider how appropriate separation distances will be maintained between activities that generate odour or dust and sensitive activities, such as residential zones. Further guidance on land-use planning and separation distances is set out in [section 5.1.1](#).

Importantly, district plans provide guidance on differing amenity expectations within different zones. These district plan provisions take precedence over the more general guidance on land-use sensitivity in this guide.

1.3.7 Alignment of regional and district council requirements

With respect to dust emissions, district plans requirements are often similar to those of regional plans. In some cases district plans have included prescriptive controls on the nature of the dust-generating activity. There is also often practical cross-over between requirements for stormwater management, sedimentation and erosion control measures with requirements for dust control measures. [Appendix 1](#) lists example assessment criteria.

There are two options for exercising local government dust management functions, either:

1. the effects of dust emissions should primarily be controlled at the regional level, or
2. a combined approach is taken, where dust emissions associated with any land use are controlled at the district level and dust emissions associated with any activity requiring consent for discharges to air, are controlled at the regional level.

Ideally, duplication between district and regional plans should be avoided. This guide recommends that regional councils and territorial authorities reach agreement as to which approach is used, and that this approach follows through into planning documents, consents and enforcement.

The types of activities that require resource consents vary between individual councils. The only way to be sure whether an activity requires a resource consent is by checking with the relevant regional and district councils, or working through the appropriate plans.

1.3.8 The Health Act 1956

Territorial authorities and public health authorities (district health boards) have a duty to improve, promote and protect public health under the Health Act 1956 (the Health Act). Territorial authorities employ environmental health officers to monitor, and take enforcement action against, conditions likely to be injurious to health or offensive, as well as to abate nuisances. Public health authorities employ health protection officers, who also have the functions of an environmental health officer under the Health Act.

District health boards often work collaboratively with regional councils to manage air discharges when there is a *health* issue arising from a discharge. In cases where dust is known

or suspected to cause adverse health effects, councils should advise public health protection officers and/or the medical officer of health.

There is some overlap between the responsibilities of regional councils under the RMA, and the responsibilities of territorial authorities and public health authorities under the Health Act. The first point of contact for air quality issues is the regional councils.

Key points

When assessing the effects for an individual discharge of dust, consider the specific requirements of relevant legislation, policy and plans in detail.

District councils have an important role to play in managing dust effects through land-use planning.

The first point of contact for air quality issues is the regional council.

1.4 Relationship management

The starting point for effective dust management is to build a positive relationship with the community affected by the dust. This will help with communication, as well as determining key concerns, and deciding and prioritising any mitigation. Early community consultation may also avoid the need to undertake the detailed assessments and methods discussed in [section 4](#).

When uncertainty and conflict increase between the discharger and community, the time and cost required to resolve issues usually also increases. This guide strongly recommends that dischargers are responsive to community concerns about dust, and work cooperatively to find solutions.

The public has the right to expect a reasonable response from regulators and dischargers when making complaints about dust. Equally, the public need to be genuine in their complaints and not complain for ulterior motives.

Where reasonable and practicable, the public can also take the initiative of attempting to resolve issues directly with the discharger. Members of the public may take common law action if they are not satisfied with the response from a council or discharger. For example, they can apply for an enforcement order under section 314 of the RMA (see [enforcement provisions](#) for more information). Alternatively, a declaratory judgment can be sought which would set out each parties responsibility.

Management options to mitigate the effects of dust are discussed in [section 5.2](#).

Key points

Establishing a positive relationship with the community affected by the dust is a good starting point for effective dust management.

Dischargers should be responsive and work with communities to find solutions.

The public has a right to expect a reasonable response from regulators and dischargers when making a complaint about dust.

2 Dust sources, properties and effects

2.1 About dust

2.1.1 What is dust?

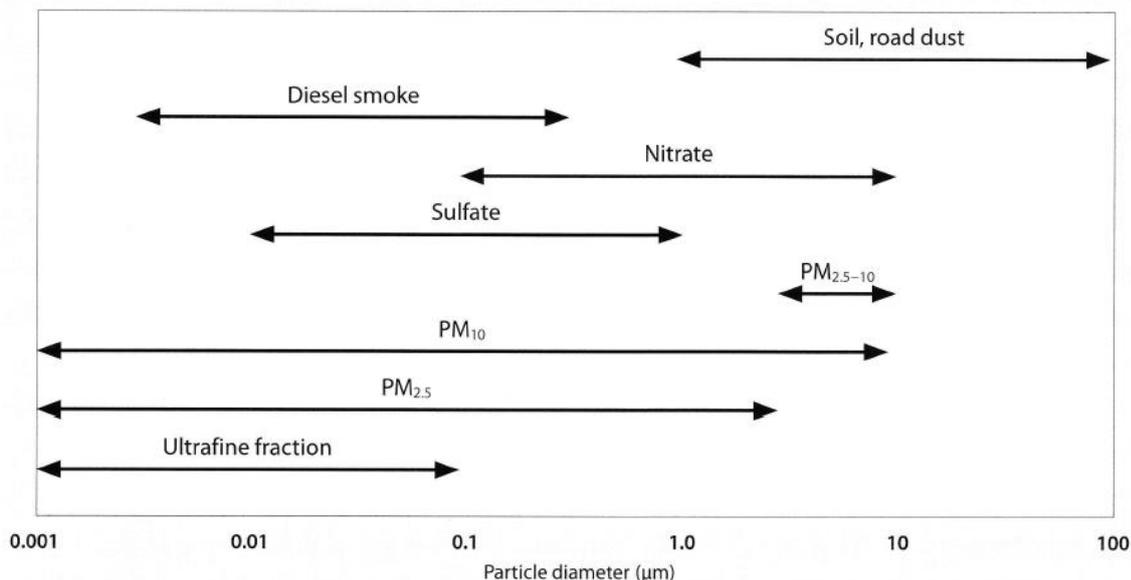
Airborne dust consists of particulate matter in the atmosphere. Particulate matter is the collective term used to describe very small solid, liquid or gaseous particles in the air. Some of these particles are big enough to be seen, while others are so small that they are invisible to the human eye and small enough to inhale. The range of particle sizes depends on source and composition as shown in figure 1.

Particulate matter includes total suspended particulates (TSP), which can be considered as anything smaller than 100 micrometres⁴ (μm) in diameter. In practice, the large particles (ie, greater than 20-30 micrometres) do not last long in the atmosphere, as they tend to fall out rapidly and settle. Particles deposited on a surface will only become individually visible at about 50 micrometres.

For the purposes of comparison, a single sheet of paper is about 100 micrometres thick, and the diameter of human hair varies from about 30–200 micrometres. A micrometre is one thousandth of a millimetre and therefore invisible to the naked eye.

Particles smaller than 10 μm in diameter are known as PM_{10} . PM_{10} includes particles referred to as 'coarse' (between 2.5 and 10 μm) and 'fine' (less than 2.5 μm , also known as $\text{PM}_{2.5}$).⁵

Figure 1: Size range of airborne particles, showing the health-related ultrafine, $\text{PM}_{2.5}$ and PM_{10} fractions and the typical size range of some major components



(Source: World Health Organisation, 2006)

⁴ A cut point of 30 μm is assigned to the standard high volume sampler.

⁵ Some publications describe PM_{10} as 'fine' particulate matter. While PM_{10} does have a fine component, it also contains a coarse component and therefore it is not referred to as 'fine' particulate matter in this guide.

When dust particles are released into the air they tend to fall back to ground at a rate proportional to their size. This is called the settling velocity. For a particle 10 micrometres in diameter, the settling velocity is about 0.5 cm/sec, while for a particle 100 micrometres in diameter it is about 45 cm/sec in still air. In a 10-knot wind (5 m/sec), the 100-micrometre particles would only be blown about 10 metres away from the source while the 10-micrometre particles have the potential to travel about a kilometre. Fine particles can therefore be widely dispersed, while the larger particles simply settle out in the immediate vicinity of the source (under calm conditions).

It is the larger dust particles that are generally responsible for nuisance effects. This is because they are more visible to the naked eye, and therefore more obvious as deposits on clean surfaces. Smaller particles (PM_{2.5} and PM₁₀) are known to cause adverse health effects.

This guide is primarily concerned with assessing and managing the nuisance effects of the larger size fraction of dust due its impact on visuals and amenity values. The primary mechanism to address the smaller dust size, PM₁₀, is the resource management instrument, the NESAQ. It is the responsibility of regional councils to comply with, implement and enforce these regulations.

2.1.2 Sources of dust

Airborne dust can be produced naturally or from human activity. It can be emitted directly or can be formed after other pollutants (such as sulphur dioxide, nitrogen oxides, and some organic compounds) undergo complex reactions in the atmosphere (secondary particulates). Information on monitoring methods for respective dust types can be found in [section 4.3](#).

Airborne dust can arise from a wide range of sources, which can be categorised as follows:

- non-combustion particulates – from non-combustion sources such as re-suspended road dust, construction work, mineral extraction, wind-blown dust and soil, and sea salt
- primary combustion particulates – produced directly from combustion, such as domestic heating, road transport, power stations, and industrial processes and are mostly PM₁₀ and PM_{2.5}. These types of dust are not visible to the naked eye but are included in this guide to encompass all sources of dust generating activities
- secondary particulates – form in the atmosphere as a result of chemical reactions following their release as gases (and include nitrates and sulphates) and are mostly PM_{2.5}.

Large quantities of dust can also be generated from natural sources, such as dry river beds, pollen from plants and volcanic eruptions.

The focus of this guide is on non-combustion particulate, primarily generated from the following sources:

- wind-blown dust from exposed surfaces such as bare land and construction sites
- wind-blown dust from stockpiles of dusty materials such as sawdust, coal, fertiliser, sand and other minerals
- dust caused by vehicle movements on sealed or unsealed roads and yards
- agriculture and forestry activities
- mines and quarries
- road works and road construction
- housing developments

- municipal landfills and other waste handling facilities
- dry abrasive blasting
- industrial operations, including grain drying and storage, flour mills, timber mills, stonemasons, mineral processing, cement handling and batching, and fertiliser storage and processing.

Figure 2: Extraction processes and material stockpiles are common sources of wind-blown dust



2.2 Effects of dust

The effects of dust are primarily determined by particle size and particle composition. Larger dust particles are generally considered to be biologically inert and their effects relate to our sense of aesthetics (soiling, visibility and amenity). However, finer dust particles (especially PM_{10} or smaller) can cause adverse health effects.

In summary, the potential effects of dust are:

- health effects from exposure to contaminants associated with the dust
- health effects from exposure to inhalable particulate matter (PM_{10} and $PM_{2.5}$)
- nuisance effects such as soiling, effects on amenity and visibility
- effects on ecosystems.

Each of these is discussed in the following subsections.

It should be noted that given the impact on human health, the NESAQ or Ambient Qir Quality Guidelines are the primary mechanisms which regional council should implement to ensure compliance with the pollutant particulate matter 10 microns or smaller. See [section 3.1](#) for further details.

Very fine dust (particularly flour and coal dust) can pose an explosive risk in confined spaces. This is primarily a workplace related issue but can also require consideration when designing abatement equipment for dust extraction (refer MfE, 2016a, Department of Labour, 1993).⁶

2.2.1 Potential health effects of contaminants associated with dust

Some nuisance dust may have the potential to cause direct health effects because of the presence of specific biologically active materials. For instance:

- some mineral dusts contain quartz (silica), the finer fractions of which can cause the lung disease known as silicosis when present at high concentrations
- some dusts may contain toxic metals such as mercury or lead
- soil from contaminated sites can contain toxins that are harmful to human health
- alkaline dusts, such as cement dust, can be irritating to the eyes
- (natural) wood dust is carcinogenic. If treated it can also contain toxic chemicals from the wood treatment processes used
- sewage sludge dust can contain pathogens that have not been deactivated during the waste water treatment process
- compost dust may contain soil microbes, allergens, and pathogens, including legionella.

In rural areas where drinking water is collected from roofs, the potential for deposition and subsequent contamination of water supply may also need to be considered.

The management procedures given in this guideline are applicable to all types of dust, regardless of their physical and chemical composition. However, those containing specific toxic components will require a tighter level of control than would be required for simple 'nuisance' dust.

Where dust may cause specific health effects, it is recommended that a suitably qualified air quality consultant be employed to assess the potential for effects. In some cases a health risk assessment may be required. Further information on assessing health effects can be found in the *Good Practice Guide for Assessing Discharges to Air from Industry* (Ministry for the Environment, 2015a).

The WorkSafe New Zealand division of the Ministry of Business, Innovation and Employment has relevant legislation and specific guidance information for dealing with occupational health issues such as exposure to asbestos.

2.2.2 Health effects from PM₁₀ and PM_{2.5}

The health effects of PM₁₀ and PM_{2.5} are predominantly respiratory or cardiovascular. The impacts range from functional changes (eg, reduced lung function) to symptoms, impaired activities (eg, school or work absenteeism), doctor or emergency room visits through to hospital admissions and death (Kuschel et al, 2012).

⁶ This includes dust collection equipment, bulk storage facilities including silos and bins used to hold dry powder, and ducting.

In October 2013, the International Agency for Research on Cancer (IARC) classified particulate matter, a major component of outdoor air pollution, as carcinogenic to humans (Group I) (International Agency for Research on Cancer, 2013). The IARC evaluation showed an increasing risk of lung cancer with increasing levels of exposure to particulate matter and air pollution. Although the composition of air pollution and levels of exposure can vary dramatically between locations, the conclusions of the IARC Working Group apply to all regions of the world.

Certain sensitive populations may experience more severe outcomes when exposed to PM₁₀ and PM_{2.5}. Such sensitive populations include more susceptible groups, such as the very young (in particular babies, infants and children), pregnant women, the health-compromised (eg, diabetics, asthmatics and people suffering from cardio-pulmonary disease) and the elderly.

The exposure-response relationship is regarded as essentially linear (ie, increasing respirable particulate matter exposure is associated with an increased frequency of effects). A 2013 review by the World Health Organisation concluded that studies do not indicate any apparent threshold below which effects do not occur (World Health Organisation, 2013). In simple terms, this means that there is no 'safe' level of PM₁₀ or PM_{2.5}.

PM₁₀ and PM_{2.5} from different sources (eg, sea salt as opposed to domestic fire emissions) have different chemical compositions and different physical characteristics. Therefore, exposure to PM₁₀ and PM_{2.5} from different sources may have different health effects. In 2013, the World Health Organisation reviewed available science on this issue and concluded:

Epidemiological and toxicological studies have shown PM mass (PM_{2.5} and PM₁₀) comprises fractions with varying types and degrees of health effects, suggesting a role for both the chemical composition (such as transition metals and combustion-derived primary and secondary organic particles) and physical properties (size, particle number and surface area).

... The integrated science assessment used evidence from both epidemiological and experimental studies to conclude that "there are many components contributing to the health effects of PM_{2.5}, but not sufficient evidence to differentiate those constituents (or sources) that are more closely related to specific health outcomes". Despite the increased number of studies (especially epidemiological) after 2009, the general conclusion remains the same.⁷

This supports WHO's earlier recommendation that all PM₁₀ is treated as being equally harmful to health, irrespective of source (World Health Organisation, 2006).

Further information on PM₁₀ can be found in *Clean Healthy Air for All New Zealanders: The National Air Quality Compliance Strategy* (Ministry for the Environment, 2011).

2.2.3 Soiling and amenity effects (nuisance)

Deposition of dust can cause soiling and amenity effects. The most common areas of concern include:

- visual soiling of clean surfaces, such as cars, window ledges, and household washing
- dust deposits on flowers, fruit or vegetables.

⁷ World Health Organisation (2013).

Dust deposits inside the house are often greatest concern in residential areas, followed by soiling of the outside of the house and the effects on paintwork. Some dusts, such as coal dust, are readily visible and will cause visible soiling at lower concentrations than many other dusts. Some dusts may be corrosive (cement and lime dust) and can cause damage to surfaces, such as paintwork.

Dusty conditions can also affect people's ability to enjoy their outdoor environment.

For most people, a major effect of a dust nuisance problem is annoyance at the increased requirement for cleaning. This can also result in a financial cost through the increased use of cleaning materials, water, property and vehicle damage and possibly paid labour.

2.2.4 Visibility (nuisance)

Airborne dust can have effects on visibility, although dust is usually less regionally significant than the effects of smoke from domestic fires and motor vehicles in urban areas. Visibility effects from dust are usually only a concern immediately around a specific source, whereas smoke effects can accumulate across a much wider area.

Visibility effects are largely a matter of aesthetics. However, it should also be recognised that visibility is one of the main ways by which people commonly judge air quality. Some people feel that the ultimate success of air quality management programmes in New Zealand will be measured against ensuring that we do not suffer the widespread degradation in visibility that has occurred elsewhere.

Loss of visibility is also a safety concern under extreme conditions, especially for road traffic or aircraft.

Guidance on atmospheric visibility degradation has been provided in the Ministry for the Environment's [Good Practice Guide for Monitoring and Management of Visibility in New Zealand](#) (Ministry for the Environment, 2001b).

In periods of very dry weather, large dust clouds may form, which can cause a reduction in visibility and significant soiling. These effects can be difficult to manage or control due to the scale of the source and area of impact.

2.2.5 Effects on ecosystems

Plants and crops

Dust deposits can have significant effects on plant life, though mainly at high dust loadings. This can include:

- reduced photosynthesis due to reduced light penetration to the leaves. This can cause reduced growth rates and plant vigour. It can be especially important for horticultural crops, through reductions in fruit setting, fruit size and sugar levels. It can also lead to reduced forestry yields
- increased incidence of plant pests and diseases. Dust deposits can act as a medium for the growth of fungal diseases. In addition, it appears that sucking and chewing insects are not affected by dust deposits to any great extent, whereas their natural predators are affected
- reduced effectiveness of pesticide sprays due to reduced penetration

- rejection and downgrading of produce due to crop blemishing. Once again, this is a particular issue for horticultural crops
- reduced palatability of pasture and associated reduced yields in terms of dairy productions.

Water

Any discharge to air which results in deposition of contaminants into water will be subject to the restrictions imposed by section 15 of the RMA.

Dust can either be deposited directly onto the surface of the water or be deposited onto land and be carried to water bodies through run off. This can result in undesirable health and environmental impacts depending upon the source of the dust particle, such as sedimentation effects, contaminated fish, harmful algal blooms, and unsafe drinking water. Of particular concern is the potential for contamination of roof-collected water supplies.

Land

Dust can be deposited directly onto land and absorbed into the soil through rainfall. Generally this is not a problem except where the dust may have toxic properties – potentially contaminating the soil.

2.3 FIDOL factors

The nuisance effects of dust emissions are influenced by the nature of the source, sensitivity of the receiving environmental and on individual perception. For example, the level of tolerance to dust deposition can vary significantly between individuals. Individual responses can also be affected by the perceived value of the activity producing the dust. For example, people living in rural areas may have a high level of tolerance for the dust produced by activities such as ploughing or top-dressing, but a lower tolerance level for dust from quarries.

Whether a dust event has an objectionable or offensive effect always depends on the frequency, intensity, duration, offensiveness/character⁸ and location of the dust event. These factors are collectively known as the FIDOL factors and are described in table 1.

Table 1: Description of the FIDOL factors

Frequency	How often an individual is exposed to the dust.
Intensity	The concentration of the dust.
Duration	The length of exposure.
Offensiveness/character	The type of dust.
Location	The type of land use and nature of human activities in the vicinity of the dust source.

Different combinations of these factors can result in adverse effects. Location is particularly important as this relates to sensitivity of the receiving environment (refer [section 2.4](#)).

⁸ In this context, offensiveness is one consideration in whether there is an ‘objectionable or offensive’ effect occurring as a result of exposure to dust.

Depending on the severity of the dust event, one single occurrence may be sufficient to consider that a significant adverse effect has occurred. In other situations, however, the event may be short enough, and the impact on neighbours sufficiently minor, that the events would need to be happening more frequently for an adverse effect to be deemed to have occurred.

2.4 Sensitivity of receiving environment

This is the 'L' for location in the FIDOL factors. Under the RMA the sensitivity of the environment must be taken into account and should be considered as part of any assessment. The sensitivity of an area will reflect both the provisions of the district plan, which specify land-use and set out amenity expectations for each land-use type, and the actual land uses that exist in the area.

It is recommended that the assessor visit the site in question to determine and/or confirm the land use, before undertaking an assessment. Regional council staff should also be able to help work out the degree of sensitivity of the surrounding land use.

When assessing air discharges the sensitivity of a particular location is based on characteristics of the land use, including the time of day and the reason that people are at the particular location.

For assessment of amenity effects, reference should be made in the first instance to the relevant district/city and, in some cases, regional plans for specific amenity values for various land-use zones. The district plan is the guiding statutory instrument for amenity.⁹

Table 2 provides examples and includes general sensitivity classifications that can be assigned to different land uses for assessment of health effects. Table 2 can also provide general guidance for assessing amenity effects in the absence of any district plan provisions.

Other factors that may determine whether an offensive or objectionable effect from dust emissions is likely to occur are the presence of background sources of dust. Cultural matters such as the presence of marae, mahinga kai, waahi tapu, churches, mosques, theatres, art galleries and sporting or recreational areas and venues may also need consideration.

Table 2: Types of land use and the general sensitivity of the receiving environment

Land use	Rating	Reasons for sensitivity
Hospitals, schools, childcare facilities, rest homes, marae	High	People of high sensitivity (including children, the sick and the elderly) are exposed, and/or People are likely to be exposed continuously (up to 24 hours, seven days a week).
Residential	High	People of high sensitivity (including children and the elderly) are exposed. People expect a high level of amenity in their home and immediate environs (ie, curtilage). People may be present all times of the day and night, both indoors and outdoors.

⁹ See for example *Crown vs InterClean* CRI 2011-092-016845 at paragraph 31.

Land use	Rating	Reasons for sensitivity
		Visitors to the area are unfamiliar with any discharges and are more likely to be adversely affected (which can cause embarrassment to residents and raise awareness of the problem).
Open space recreational	Moderate to high	These areas are used for outdoor activities and exercise, in circumstances where people tend to be more aware of the air quality. People of all ages and sensitivity can be present.
Tourist, cultural, conservation	High	These areas may have high environmental values, so adverse effects are unlikely to be tolerated.
Commercial, retail, business	Moderate to high	These areas have a similar population density to residential areas as people of all ages and sensitivity can use them. Commercial activities may also be sensitive to other uses (eg, food preparation affected by volatile organic compounds emissions from paint manufacture). There can be embarrassment factors for businesses with clients on their premises. Note: Need to consider the time of day, nature of activity, and likelihood of exposure (people are typically present less than 24 hours per day).
Rural residential/ countryside living	Moderate to high	Population density is lower than in residential areas, so the opportunity to be adversely affected is lower. However, people of high sensitivity can still be exposed at all times of the day and night. Often people move into these areas for a healthier lifestyle and can be particularly sensitive to amenity issues or perceived health risks.
Rural	Low for rural activities; moderate or high for other activities	A low population density means there is a decreased risk of people being adversely affected. People living in and visiting rural areas generally have a high tolerance for rural activities and their associated effects. Although these people can be desensitised to rural activities, they may still be sensitive to other types of activities (eg, industrial activities).
Heavy industrial	Low	Adverse amenity effects tend to be tolerated, as long as the effects are not severe. Many sources discharge into air, so there is often a mix of effects. People who occupy these areas tend to be adult and in good physical condition, so are more likely to tolerate adverse effects, particularly if the source is associated with their employment. Note: Need to consider the time of day, nature of activity, and likelihood of exposure (people are typically present less than 24 hours per day).
Light industrial	Moderate	These areas tend to be a mix of small industrial premises and commercial/retail/food activities. Some activities are incompatible with air quality impacts (such as food manufacturers not wanting odours from paint spraying), while others will discharge to air. Note: Need to consider the time of day, nature of activity, and likelihood of exposure (people are typically present less than 24 hours per day).
Public roads	Low	Roads users will typically be exposed to adverse effects from air discharges for only short periods of time.

Key points

Dust assessments should take into account:

- the frequency, intensity, duration and characteristics of the dust
- location, ie, sensitivity of the receiving environment with respect to the time of day and likelihood of people being exposed to dust and/or amenity provisions of the district plan and/or actual land use
- background dust
- perception and cultural issues.

It is recommended that the assessor visit the site in question to determine and/or confirm the land use, before undertaking an assessment.

3 Air quality criteria and consent conditions

Most unitary, regional and district councils have recognised the need for controls on dust effects and manage these through rules in their respective plans and conditions in resource consents. This section discusses air quality criteria and consent conditions relating to discharges of dust.

3.1 Air quality criteria

The effects of dust are often assessed and managed qualitatively. However, in cases where there may be adverse effects due to the scale of the activity and/or the sensitivity of the receiving environment, quantitative assessment and/or ambient monitoring are undertaken. This section describes the assessment criteria used in such quantitative assessments.

While this guide focusses on nuisance effects from deposited dust, which are generally greater than 10 microns, it acknowledges that suspended dust includes particles less than 10 microns. These particles may cause wider ambient air issues, and may have health effects due to its ability to penetrate further into the respiratory tract.

To determine whether the effects of an industrial development on ambient air quality are 'acceptable' the ambient air quality criteria are used to provide minimum requirements to protect human health and the environment.

The New Zealand regulatory framework contains the following air quality criteria:

- national environmental standards for air quality¹⁰ (NESAQ)
- national ambient air quality guidelines
- objectives and policies in some regional plans.

It is important to note that regional plans are statutory instruments under the Resource Management Act (RMA). If the air quality objectives in a regional plan are more stringent than the national environmental standards for air quality, then the regional plan takes precedence. For this reason it is very important to check the requirements of the relevant regional plan before undertaking any assessment of dust.

A thorough dust assessment should consider the potential effects of both short-term (acute) and long-term (chronic) exposure to particulate if exposure over both periods may occur.

3.1.1 National air quality standards and guidelines

Schedule 1 of the NESAQ includes an ambient concentration limit for PM₁₀ set as a 24-hour average (refer table 3, which follows). Schedule 1 further provides that this concentration limit may be exceeded once in any 12-month period.

¹⁰ Resource Management Act (National Environmental Standards for Air Quality) Regulations 2004.

Detailed guidance on the PM₁₀ NES is provided in the *2011 Users' Guide to the Revised National Environmental Standards for Air Quality: Updated 2014* (Ministry for the Environment, 2014). A number of key issues relevant to the assessment of dust are summarised and discussed here.

The PM₁₀ NES applies in the open air everywhere people are likely to be exposed. This includes roadside verges, residential areas, central business districts, parks and beaches.

Areas that are *not* in the open air and where the PM₁₀ NES does not apply include inside:

- a building
- tunnels
- vehicles.

The PM₁₀ NES is also not applicable on sites to which resource consents apply. For example, Acme Cement may operate a large factory, with emission limits specified in their resource consent for discharges of PM₁₀. The PM₁₀ NES does not apply on Acme's site (workers on the Acme site being protected under health and safety legislation). However, at the house next door (and so off-site), the PM₁₀ NES does apply. This is to protect the health of any members of the public that may be exposed to emissions of PM₁₀ from Acme.

New Zealand's *Ambient Air Quality Guidelines* (Ministry for the Environment, 2002) includes an ambient concentration limit for PM₁₀ set as an annual average. This value mirrors the global air quality guideline for PM₁₀ published by the World Health Organisation (WHO) in 2006 (World Health Organisation, 2006).

The WHO global air quality guidelines also include concentration limits for PM_{2.5} as both 24-hour and annual averages. The WHO 24-hour average PM_{2.5} guideline is consistent with the New Zealand monitoring PM_{2.5} guideline (Ministry for the Environment, 2002).

Table 3 lists current New Zealand and WHO standards and guidelines for particulate matter. The WHO global air quality guidelines are not statutory guidelines in New Zealand, but it is good practice to consider them when determining whether a discharge is likely to have a significant adverse effect.

Table 3: Ambient air quality standards and guidelines for particulate matter

Pollutant	Concentration limit (µg/m ³)	Averaging time	Source
PM ₁₀	50	24-hours*	NES for air quality
	20	Annual	NZ ambient air quality guideline
PM _{2.5}	25	24-hours	NZ monitoring guideline
	10	Annual	WHO global air quality guideline

* One permissible exceedance in a 12-month period

PM₁₀ and PM_{2.5} are non-threshold contaminants, ie, carcinogenic substances with no known safe level of exposure. Any increase in ambient concentrations will result in adverse effects. This means that the air quality criteria for PM₁₀ and PM_{2.5} should not be used as a limit to pollute up to.

3.1.2 Regional air quality plans

Regional air quality plans reflect particular regional circumstances and may range from the very straightforward, dealing primarily with issues of open burning, to the more complex, with specific rules and plans for meeting the PM₁₀ NES. It is important to understand the policies and objectives of each regional plan when considering the application of air quality criteria (sometimes referred to as guidelines, targets or goals).

Regional air quality plans give effect to the NES for air quality. Where air quality criteria conflict the more stringent standard in a particular instrument applies. So a regional air quality rule that is more stringent than the PM₁₀ NESAQ supersedes the PM₁₀ NESAQ (for example, Otago Regional Council's target of 33 µg/m³ for PM₁₀). The regional air quality rules cannot, however, be more lenient than the air quality NES.

This means regional plans could:

- require activities to meet a more stringent ambient PM₁₀ standard than that given in table 3
- provide additional criteria for various types of particulate, including PM_{2.5}, total suspended particulate (TSP) or deposited dust or for other monitoring periods.

For these reasons, when seeking guidance on what criteria should be used the only sure way is by checking with the relevant regional council or working through the appropriate regional plan.

For regional plans that are not operative, the weight given to proposed assessment criteria will need to be carefully reviewed in light of national and international best practice.

3.1.3 Trigger levels – TSP and PM₁₀

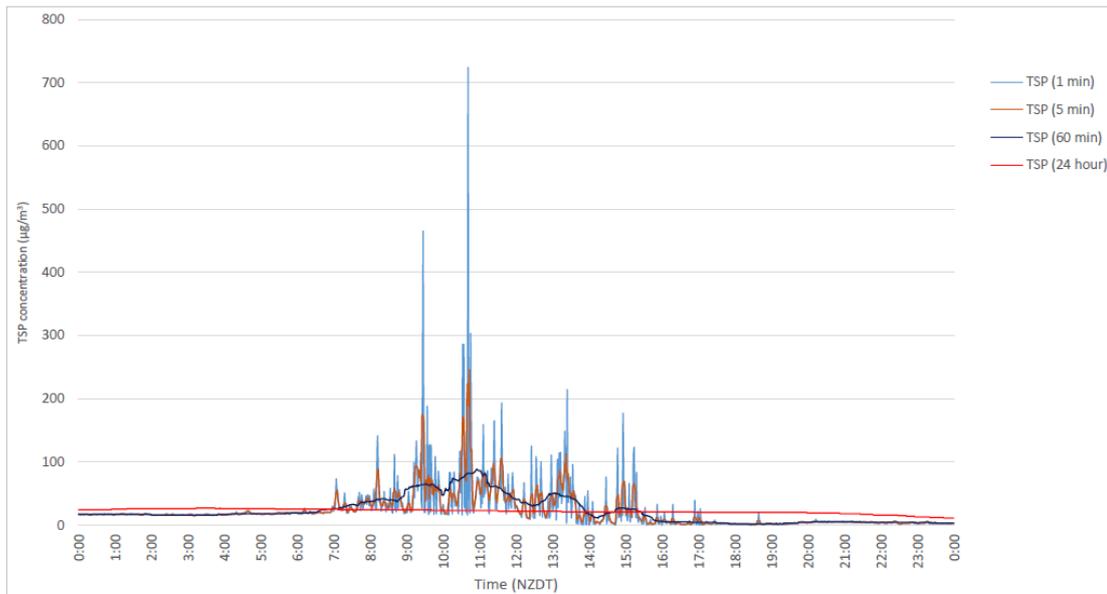
Where there is potential for significant adverse effects beyond the site boundary, trigger levels for total suspended particulate (TSP) or PM₁₀ can be set to prompt action to control dust, for example applying more water for dust suppression or stopping certain activities.

As continuous monitoring is relatively expensive, a management approach using monitoring and trigger levels is typically only carried out in circumstances where people may reasonably be exposed over a 24 hour period. Monitoring is generally recommended for either PM₁₀ or TSP (ie, not both). Trigger levels are not generally recommended for areas of low sensitivity (refer district plan provisions or table 2).

However, this 24 hour averaging period is based on the potential adverse health effects of exposure to PM₁₀. Experience with quarries has shown that dust events correlating with objectionable or offensive effects are often intense, but of relatively short duration (seconds to minutes). Monitoring TSP over a 24 hour period therefore, can mask significant dust issues.

Similarly, even monitoring TSP as a one hour average can hide 'one-off' issues when the severity of the dust nuisance occurs over a few minutes during that hour. This is shown in figure 3 where a dust complaint correlated with very high measured TSP levels – but only over very short averaging time periods (ie, 1 and 5 minutes).

Figure 3: Different TSP averaging periods for a Quarry (19 Feb 2016; day of dust complaint)



Suggested trigger levels for on-site dust control are given in table 4 (TSP) and table 5 (PM_{10}).

These triggers are intended to be used for the proactive management of dust on site. They are not intended to be used for enforcement because exceedance of trigger levels does not necessarily infer an adverse effect offsite.

The TSP trigger levels have been successfully used to control dust on New Zealand Transport Agency road construction projects¹¹ and have also been found effective by regional councils and independent consultants at reducing dust complaints on other sites (eg, quarries).

The PM_{10} trigger level is based on international best practice for control of dust from construction and demolition activities (Greater London Authority, 2014).

Swift implementation of dust control measures following the suggested trigger levels being approached or exceeded should help manage adverse health effects and prevent exceedance of the PM_{10} NESAQ.¹²

The trigger levels may be appropriate for other activities however, this should be determined on a case-by-case basis to account for site specific factors such as:

- source (eg, size of the source/operation and the type and colour of dust)
- terrain and separation distance to sensitive receptors
- monitoring location (eg, trigger levels set at the site boundary may be higher than those set for monitoring locations at sensitive receptors or other off site locations)
- type of monitoring (eg, light scattering methods can underestimate PM_{10} and TSP compared with beta attenuation monitors)
- existing background concentrations (of PM_{10} or TSP) in the receiving environment.

Dust issues are exacerbated under dry, windy conditions, so trigger levels for wind and rain conditions are also provided.

¹¹ Waterview Connection and Mackays to Peka Peka.

¹² In the absence of background exceedances due to domestic fires.

Table 4: Suggested trigger levels for total suspended particulate (TSP)

Trigger	Averaging period	Sensitivity of receiving environment [*]		
		High	Moderate	Low
Short term	5 min	250 µg/m ³	n/a	n/a
Short term	1 hour	200 µg/m ³	250 µg/m ³	n/a
Daily**	24 hours (rolling average)	60 µg/m ³	80 µg/m ³	100 µg/m ³
Wind warning	1 minute	10 m/s (during two consecutive 10-minute periods)		
Rain warning	12 hours	There has been no rain in the previous 12 hours		
Visible dust	Instantaneous	Visible dust crossing the boundary		

* In general, all residential areas will be high sensitivity (refer district plan provisions or table 2).

** For managing chronic (ie, long term) dust only

Table 5: Suggested trigger levels for PM₁₀

Trigger	Averaging period	Sensitivity of receiving environment [*]		
		High	Moderate	Low
Short term	1 hour	150 µg/m ³	n/a	n/a

* In general, all residential areas will be high sensitivity (refer district plan provisions or table 2)

3.1.4 Trigger levels – deposited dust

Table 6 provides a recommended trigger level for deposited dust.

Table 6: Recommended trigger levels for deposited dust

Trigger	Averaging period	Trigger levels (above background concentration)*
Monthly	30 days	4 g/m ² /30 days

* Refer [section 4.6](#)

The deposited dust trigger level may not be appropriate for all circumstances. For example, some industrial or sparsely populated areas may not be troubled by deposition rates of more than 4g/m²/30 days above background levels. Conversely, some highly sensitive residential areas may find deposition rates of 2g/m²/30 days (above background levels) objectionable and offensive.

It should also be noted that the nature of the dust may also be relevant to the dust deposition trigger level that is appropriate. Highly visible dust, such as black coal dust, will cause visible soiling at lower concentrations than many other dusts.

The recommended trigger level for deposited dust normally applies to insoluble matter. This is because dissolved material is not significant when assessing nuisance effects from the majority of dust sources. However, consideration should be given to including analysis of water soluble emissions where these may be the cause of nuisance dust effects, for example particle emissions from a pulp and paper mill, milk powder plant, or fertiliser works.

The deposited dust trigger level should only be considered in conjunction the results of other assessments, including complaints surveys and community consultation. Site-specific dust

deposition trigger levels may be developed in consultation with the local community, to ensure they are acceptable to the local community.

Estimates of background dust levels (refer [section 4.6](#)) must be included when calculating values to compare with any deposited dust trigger levels.

3.2 Consent conditions

Conditions in resource consents relating to dust must be clear, reasonable and enforceable. Because dust effects can be subjective, there are special considerations when writing consent conditions for dust management. In particular, a condition relating to ‘no offensive or objectionable dust effect’ will often require supporting conditions, for example:

- dust trigger levels (see [section 3.1](#))
- control equipment and performance requirements (eg, bag filters)
- operating and management requirements (eg, on-site vehicle speed limits, specifying the use of water carts).

In this way, councils use design specifications in consent conditions to ensure control equipment meets, and continues to meet, the emissions assessed at the time of consent. Conditions must balance flexibility for the consent holder to use any technology to achieve dust reductions, and certainty for the regional council and neighbours that the consent holder will use appropriate technology. Consent conditions must also be practical, and able to be monitored to demonstrate compliance.

Recommended consent conditions that may be applied to air discharge permits for diffuse dust sources, such as quarries and stockpiles include conditions requiring:¹³

- that specific dust control measures described in the application are implemented
- the consent holder to record any complaints relating to the dust discharge. This record should include the location, date and time of complaint, a description of weather conditions (notably wind speed and direction), any identified cause of the complaint, and the corrective action taken
- that there shall be no noxious, dangerous, objectionable or offensive dust to the extent that the discharge causes an adverse effect at or beyond the boundary of the site.

Conditions requiring dust monitoring may be imposed where there is potential for significant adverse effects beyond the site boundary. Suggested trigger levels for on-site dust management are provided in [section 3.1](#).

This guide recommends, as a minimum, that access to meteorological monitoring (ie, wind direction and wind speed) be included as a condition of consent for any activity with potentially significant dust discharges (eg, a large quarry with residences located on the boundary). Local meteorological data is particularly useful for investigating dust complaints. A variety of low-cost monitoring options are available in the absence of publicly available representative meteorological data.

¹³ The specific nature of conditions will depend on the scale and significance of the activity, having regard to the sensitivity of the receiving environment.

As far as practical, siting of meteorological monitoring instruments should meet the AS/NZS 3580.1.1:2007 Methods for sampling and analysis of ambient air – Guide to siting air monitoring equipment standard.

While councils have discretion when considering consent duration, [section 5.1.3](#) outlines key parameters that may be relevant when considering term of consent. For further information on drafting consent conditions, refer to the [Quality Planning website](#). Some examples of consent conditions are provided in the *Good Practice Guide for Assessing Discharges to Air from Industry* (Ministry for the Environment, 2016b).

Key points

Conditions included in resource consents to manage dust should be clear, reasonable and enforceable.

Availability of meteorological monitoring data (ie, wind direction and wind speed) should be included as a condition of consent for any activity with potentially significant dust effects.

3.2.1 Noxious, dangerous, offensive or objectionable dust

The primary recommended consent condition for managing off-site effects of dust is:

There shall be no noxious, dangerous, objectionable or offensive dust to the extent that it causes an adverse effect at or beyond the boundary of the site.

It is usually not enough for dust to simply be detected at or beyond the boundary of a site. As discussed in [section 3.3.1](#), the dust must be sufficient to create an adverse effect and the dust must be objectionable or offensive in the opinion of an ‘ordinary reasonable person’. Some dusts, particularly if they have health effects due to their constituent materials, may be noxious or dangerous at very low levels. However, this requires assessment against numeric air assessment criteria rather than a FIDOL assessment.

In the absence of any numerical dust consent conditions, determining if dust is offensive or objectionable (and so a breach of consent) is always dependent on all of the FIDOL factors, and proof is required before enforcement action can be taken.¹⁴ For a breach of the condition to occur, this generally requires a council officer to validate a dust complaint by determining the dust was offensive or objectionable in that instance.

All the recommended assessment methods (see [section 4](#)) may be used to determine whether the consent condition can be, or is being, complied with for an individual discharge source.

The following points should be taken into account when assessing and managing dust.

1. The assessment as to what constitutes an offensive or objectionable effect should be determined by trained persons, such as council officers, according to clear criteria. A format for investigating and recording complaint investigations is provided in [Appendix 2](#).

¹⁴ If monitoring shows that criteria specified in the consent have been exceeded (where the criteria are set at levels where a breach would be deemed to be offensive or objectionable dust levels) then this may be sufficient on its own to show non-compliance and that an adverse effect has occurred.

2. The assessment will need to take into account the frequency and duration of nuisance events, the quantity of dust emissions/deposition, the particular characteristics of the dust (eg, colour, composition) and the sensitivity of the receiving environment.
3. It is unusual for a single isolated dust incident to be cause for enforcement action. More commonly, acute dust events are a signal that greater attention is required to dust control measures. In the event of recurrent complaints, the discharger should be required to keep a complaint register (if this is not already being done). The council should also record and investigate complaints.
4. Where regular complaints occur, the discharger should also be required to set up procedures for regular consultation and communication with the affected community. A dust monitoring programme, with trigger levels for when actions are required, should be considered. Implementation of effective dust control measures, as outlined in [section 5](#), may eliminate the need for further action.
5. If dust issues continue, then the council should consider taking some of the actions available to it under the Resource Management Act (RMA). This could include one of an:
 - infringement fee of between \$300 to \$1000 to address minor matters
 - abatement notice, which requires the discharger to cease or control specific activities
 - enforcement order that must be obtained from the Environment Court.

The enforcement order would require the operator to implement proper corrective actions immediately.

6. If legal action is considered, then the council should ensure that a full range of evidence has been gathered for the assessment of environmental effects. The council should attempt to collect visual evidence of the problem, such as photographs or videos, and should record or investigate the meteorological conditions during the incident(s).
7. The results from an existing dust monitoring programme may also be used in support of any action. Alternatively, the council should consider carrying out short-term measurements during specific dust events.

Key points

Conditions for managing dust on resource consents should be certain, relevant to the discharge, reasonable and enforceable.

The recommended consent condition for managing off-site effects of dust is:

There shall be no noxious, dangerous, objectionable or offensive dust to the extent that it causes an adverse effect at or beyond the boundary of the site.

The descriptors 'objectionable' or 'offensive' should always be used in conjunction with the term 'effect' rather than 'objectionable or offensive dust' per se.

3.2.2 Best practicable option

Section 108(1)(e) of the RMA makes provision for a consent holder to be required to adopt the best practicable option (BPO) to control any adverse effects caused by an activity. The BPO for the discharge of a contaminant (in this case, dust) is defined in section 2 of the RMA as the:

best method for preventing or minimising the adverse effects on the environment having regard, among other things, to—

- (a) the nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; and
- (b) the financial implications, and the effects on the environment, of that option when compared to other options; and
- (c) the current state of technical knowledge and likelihood that the option can be successfully applied.

Section 108(8) of the RMA restricts the requirement for BPO to being the:

most efficient and effective means of preventing or minimising any actual or likely adverse effect on the environment.

When applying the test of efficiency and effectiveness, the regulatory authority needs to consider not just the efficiency from the applicant's viewpoint, but also the council's and community's perspective.

Further information on dust control is provided in [section 5](#).

Key points

Consider the requirement for the best practicable option as a consent condition. This may be the most efficient and effective means of preventing or minimising the adverse effects of odour.

When assessing efficiency and effectiveness of the BPO, consideration should be given to the applicant's viewpoint and the council's and community's perspective.

Requiring the best practicable option can still provide flexibility to enable change, provided the effects remain the same or decrease.

3.2.3 Dust management plans

Management plans can be used to show how an activity will comply with the conditions of resource consent and manage adverse effects.

The [Quality Planning website](#) provides guidance on the role of management plans, and states:

Critical actual or potential adverse effects need to be identified, appropriately avoided, remedied or mitigated with conditions before a decision to grant is made and not left to be addressed via a future management plan. Management plans should be limited to non-critical operational processes that lie behind a performance or operational standard.¹⁵

It is important that management plans are 'living documents', regularly updated. They should be comprehensive, and it is good practice for the management plan to be made available at the time of applying for a resource consent (albeit in draft form covering key operational matters, pending consent). [Appendix 3](#) outlines the recommended minimum requirements for a dust management plan.

¹⁵ www.qualityplanning.org.nz/index.php/consents/conditions.

Dust management plans can take two forms:

1. a draft management plan may be certified by the local authority (or the Court, in the case of an appeal) and requirements relating to its content written into the conditions of the resource consent, or
2. the resource consent requires the consent holder to prepare and lodge a management plan with the local authority after the consent is granted.

It is not generally recommended to include the entire management plan as a condition of consent. It is preferable to include specific mandatory aspects of the management plan as consent conditions. However, if a management plan is required to be *produced* (as condition of consent) then it is preferable to have another consent condition facilitate the plan being *used* in practice (eg, by requiring regular updates).

A future management plan can be required by a condition of consent where the management plan provides detailed information on how the consent holder will comply with other conditions of the consent. However, a management plan lodged after a consent is granted cannot be subject to the approval of the council.

Management plans may be used to clarify how compliance will be achieved, but they should not be relied on as the sole way to ensure a critical performance or environmental standard will be achieved. Conditions that require a management plan cannot specify what must be in the management plan (eg, particular ways of doing things). The condition can only require that there has to be a management plan, with procedures and measures, to achieve specific things. A condition like this also assumes methods are readily available to enable compliance with the condition.

Additional guidance on management plans is provided on the [Quality Planning website](#).

Key points

Draft management plans should cover all key operational matters and ideally made available at the time of applying for the resource consent.

Conditions relating to management plans cannot reserve the power to approve conditions outside the formal resource consent process. This is because conditions must not unlawfully delegate or defer matters essential to the consent itself. This means that a council cannot reserve the right of approval over management plans submitted after the granting of the consent.

4 Assessment of environmental effects from dust

Detailed guidance on how to prepare an assessment of environmental effects is provided in the *Good Practice Guide for Assessing Discharges to Air from Industry* (Ministry for the Environment, 2016a). This guide outlines aspects of effects assessment that are specific to dust.

A basic level of dust assessment should include:

- a description of the site and receiving environment (in terms of proximity to sensitive receptors and background air quality)
- an outline of the potential activities to take place (including hours of operation and duration)
- the potential nature and scale of dust emissions generated by an activity (or stages of a project)
- the predicted level of potential adverse effects on health and amenity (eg, soiling, visibility) due to the nature and scale of potential dust emissions.

4.1 Qualitative assessment

The emphasis with dust assessments is often on management and control of dust to avoid adverse effects. This is recognised in the risk-based approaches outlined below.

All qualitative dust assessments must consider all FIDOL factors described in table 1.

It is recommended that the assessor visit the site in question to determine and/or confirm the land use, before undertaking an assessment.

Although it has not been widely used, dust deposition ‘intensity’ could be measured on an intensity scale, similar to odour, from no dust (0) to extremely heavy dust deposition (6) as shown in table 7. While dust intensity is subjective (different people will perceive dust levels as different intensities), this approach may provide a useful quantitative tool for estimating dust intensity.

Table 7: Dust intensity scale¹⁶

Dust intensity	Intensity level
Extremely heavy	6
Very heavy	5
Heavy	4
Distinct	3
Light	2
Very light	1
No dust	0

¹⁶ Based on the odour intensity scale in Verein Deutscher Ingenieure 3882 (Part 1) October 1992 Olfactometry – Determination of odour intensity.

4.1.1 Dust diaries

Dust diaries can be used by people in affected communities to record their daily exposure to dust. A dust diary programme can be useful for collecting data on the frequency, intensity, duration, and character of dust impacts at various locations over a given period. They can help to inform a FIDOL assessment to evaluate the overall level of adverse effect from a dust source. Dust diaries generally need to be completed for at least three to four months to provide meaningful information.¹⁷

If there are sufficient respondents and spatial coverage, the resulting data can be used to calculate the percentage of time (hours/year) that people are exposed to dust from a specific source. The information recorded in a comprehensive diary programme includes:

- date and time of day
- duration of the event
- continuity of the dust event
- character and amount of dust particles
- likely source of dust
- wind direction and strength.

An example of a dust diary record sheet is provided in [Appendix 2](#).

Diarist fatigue is a major obstacle in completing a diary for anything other than a very short time and frequent contact and encouragement should be given. Careful consideration should be given to the purpose of the diary, what subsequent analysis will be undertaken, how long analysis will take, and what resources are available for analysis. Diaries should not be used to simply stop a person calling the council.

Dischargers should give diarists instructions on how to record information so it is as consistent as possible. Diarists should also be given feedback on the programme as a courtesy in return for their efforts. A less comprehensive diary programme in some situations may be sufficient, for example when the aim is to investigate whether a dust source is still having an impact on the community.

Dust diaries are emerging as good practice in New Zealand. Their use may be subject to significant review and improvement in the future.

4.1.2 Community meetings

For sites experience ongoing complaints, community meetings are sometimes used to gauge the extent of any dissatisfaction due to exposure to dust. Holding an open public meeting is generally a first step, and meeting attendees may establish a community liaison sub-group from the meeting. This group can be used as a forum to negotiate solutions and to provide direct and ongoing community input on dust issues. The community should decide membership of the liaison sub-group in a democratic and transparent manner. It must be noted that the views of the group are only indicative of those in the wider community, and other tools such as newsletters may be useful to ensure the wider community is kept informed on an ongoing basis.

¹⁷ This may not be the case in the event of severe, prolonged dust events.

In situations where there are only one or two complainants, open public meetings can be used to see whether there is a more widespread problem. This can indicate whether complainants may be vexatious or are particularly sensitive; that is, not representative of the 'ordinary reasonable person'.

Community consultation is useful to investigate whether people consider that any dust is of an acceptable level. Sometimes concerns are raised during consultation such as at the consent renewal time, even though there have been no formal complaints made. Ongoing, honest and transparent dialogue between dust producers and potentially affected communities is recommended to allow dischargers to deal with issues as they arise. This can prevent ill feelings building up in the community.

Community liaison groups normally include:

- management and engineering staff from the site producing the dust
- members of the local community
- council officers.

An independent mediator/chairperson may chair the group meetings. Normal meeting rules and standard procedures should be followed to ensure meetings run smoothly. Minutes, and matters arising from the minutes, should be recorded and discussed.

Further guidance on running community consultation can be found on the [Quality Planning website](#).

Key point

Community meetings and liaison groups can be useful tool to provide community input into dust issues.

4.1.3 Risk-based assessment tools

Two new risk-based approaches to assessing dust are outlined below. Although both were developed to assess dust effects from construction activities, the methods may have more general application to other dust generating activities. Either of the two approaches may be used (ie, there is no preference of one over the other), provided the limitations are understood for each and assumptions clearly stated. They have not been used widely in New Zealand to date and their future use may be subject to significant review and amendment in the future.

Any qualitative dust assessment should always consider all FIDOL factors as outlined in table 1 (refer [section 2.3](#)).

Dust risk index (New Zealand Transport Agency)

The New Zealand Transport Agency has developed a Dust Risk Index (DRI) approach to assessing air quality effects generated from construction activities. The DRI generates a number that identifies the risk of dust generation during construction. The higher the DRI, the greater the likelihood of dust-related issues (New Zealand Transport Agency, 2014).

The DRI is calculated using the following parameters:

- surface exposure
- exposure period
- mitigation
- time of year
- wind speed
- wind direction
- distance to the nearest receiver
- construction activity.

The full detailed methodology is available in the [Guide to Assessing Air Quality Impacts from State Highway Projects](#) (New Zealand Transport Agency, 2014).

Note: This guide recommends explicit consideration of all FIDOL factors (refer [section 2.3](#)) for any qualitative dust assessment.

Assessment of Risk (IAQM)

The Institute of Air Quality Management (IAQM) has developed guidance on how to perform an impact assessment and classify the risk of dust impacts from a construction and demolition activity (Institute of Air Quality Management, 2014). Although this was developed for construction and demolition activities in the UK, the guidance and methodologies can be adopted and modified for any type of dust-generating activity.

The guidance considers the different potential impacts of construction demolition, earthworks, construction and trackout (ie, tracking of material on vehicle tyres, see Glossary) activities. The potential for dust emissions is assessed for each activity the following impacts are considered:

- annoyance due to dust soiling
- the risk of health effects due to an increase in exposure to PM₁₀
- harm to ecological receptors.

The assessment is then used to develop mitigation actions.

The steps undertaken for the assessment are as follows:

- Step 1: Screen the requirement for a more detailed assessment
- Step 2: Assess the risk of dust impacts in terms of low, medium or high risk
- Step 3: Determine site-specific mitigation for each activity depending upon the level of risk assessed in Step 2
- Step 4: Examine the residual effects and determine whether or not these are significant
- Step 5: Prepare the dust assessment report.

The detailed methodology and steps are available in the [Guidance on the Assessment of Dust from Demolition and Construction](#) (Institute of Air Quality Management, 2014).

Note: This guide recommends explicit consideration of all FIDOL factors (refer [section 2.3](#)) for any qualitative dust assessment.

4.2 Complaint investigation and analysis

Responding to dust complaints and/or evaluating complaints records are methods of directly assessing the nuisance effects of dust emissions. However, it has a number of shortcomings, including:

- some people may be reluctant to complain, or simply not know who to complain to
- other people may complain excessively, or make frivolous complaints, because they are opposed to a particular activity
- people may stop complaining about a continuing problem, if they feel that no action is being taken
- tolerance or intolerance to dust deposition and airborne dust can vary considerably with individual perception and health status
- the source of dust may be difficult to identify, so that one activity may be wrongly blamed for the actions of another.

Notwithstanding these limitations, complaint response systems still have an important part to play in managing dust problems. Prompt responses to complaints are important in developing good relations between an operator and the surrounding community. Effective complaint investigation can also be important in identifying parts of the operation where dust control procedures need to be improved.

Complaints that have been validated during an inspection by a council officer or cross-checked against wind direction are extremely useful, regardless of population density or other dust sources. Provided these are comprehensively documented (see [section 4.3.1](#)), they can form the basis for a successful prosecution.

Councils have a duty under section 35(5)(i) of the RMA to make a summary of all written complaints received concerning alleged breaches of the RMA, and the details of how the complaint was dealt with. When a complaint is received, the details should be recorded in a complaint database or log. If a site inspection was not possible, date, time and location information can be used with the operating status of the alleged source and data on wind conditions at the time (from monitoring records) to help determine whether the complaint was valid.

Complaints should always be recorded, even where the complaint cannot be investigated by a site inspection, such as when staff are unavailable outside normal working hours. Complaint incidents can be used to build up a long-term picture of dust effects, and provide a measure of the cumulative effects of repeated incidents.

A chronological summary of dust complaints can be used to indicate changes in long-term dust exposure. Trends can illustrate seasonal changes in complaint frequency, which may be due to changes in plant production or in the prevailing meteorology.

Complaints can contribute to evidence of an effect but, in conjunction with other techniques, can also be useful in determining a likely distance for consideration of written approvals from affected parties or notification areas.

4.2.1 Investigating procedures for council officers and independent assessors

This section outlines good practice for investigating dust complaints. These procedures equally apply to both council officers and independent assessors, and additional considerations for council officers are noted where relevant.

Council officers (or nominated representatives) should carry out a site investigation in response to a dust complaint. Good practice is for officers to respond within 90 minutes of receipt of a complaint. In larger regions these response times may be impracticable and training other council staff or employing independent assessors should be considered.

It is difficult to validate complaints in every instance, because dust emissions are often highly variable with time and weather. Furthermore, dust complaints may relate to a build-up of material over a period of time (eg, I cleaned this windowsill two weeks ago and now it is filthy again), which can make determining the source of the dust difficult.

Dust complaint investigations have two primary aims, both equally important. These are to:

1. form an objective opinion as to whether the dust is having an offensive or objectionable effect on that specific occasion, and to determine the cumulative effect, if any, of the dust
2. comprehensively document the dust assessment to help resolve the dust nuisance.

Council officers may also be looking to gather evidence for future compliance action (including prosecution), or to make decisions on resource consent applications, but in all instances consistent procedures for dust complaint investigation and reporting are critical. The recommended complaint investigation and recording procedure is provided in table 8. An example complaint investigation form is given in [Appendix 3](#).

Table 8: Complaint investigation and recording procedure

Step	Action
Step 1: Receive the complaint	1 Record the date, time and location of complaint and the complainant's description of the alleged dusts event, including frequency (continuous or intermittent), duration and description/type of dust. Consider asking for assessment of intensity (refer table 7). If possible, record complainant's name and their estimate of wind direction and wind speed (or just general weather conditions).
Step 2: Visit the location of the complaint.	2 Record the time of arrival on the Investigation Form (see Appendix 3). 3 Assess and record the FIDOL factors including frequency, duration and type of dust. Consider inclusion of dust intensity (refer table 7). Record when the surfaces were last cleaned and how frequently they are cleaned/dust is removed. 4 Take photos of the dust and if possible samples for future analysis. 5 Record the wind direction and strength and weather conditions throughout the investigation, and how these were determined.
	6 Determine from table 9 the type of impact the dust has, considering the location and observations recorded. Also record any other details to help in assessing the level of dust effect such as adverse health effects (stinging eyes, cough) and/or amenity such as references to soiling (permanent or temporary) and costs of cleaning. 7 Record any other potential dust sources near the complainant's location.

Step	Action
	8 Record the time of departure from the complainant's location.
Step 3: If there is an effect from the dust and the source is identified	<p>9 Assess the dust upwind of the suspected source. Where practicable, conduct a 360 degree sweep around the source to eliminate other possible sources of dust.</p> <p>10 Record any observations of visible dust or obvious dust sources at other locations surrounding the alleged source, including times of observations at each location.</p> <p>11 Visit the suspected source of the dust and explain the findings of the investigation to site staff.</p> <p>12 Confirm the site operations taking place at the time of the complaint, and any other operations that may have occurred recently that may be related to dust build up over time.</p> <p>13 Request an explanation for the dust discharge (if appropriate warn that their statement may be used in evidence).</p> <p>14 Record the name(s) of persons spoken to at the site and their comments.</p> <p>15 Review monitoring and compliance against any consent conditions or rules in plans, and take any samples necessary to allow for comparisons between samples at complainant's location. Copies of records and any other evidence should also be collected.</p> <p>16 Investigate whether dust is from normal or abnormal operations, and record evidence to support the conclusions made.</p>
Step 4: Make an overall assessment	17 Make an overall assessment of adverse effects beyond the boundary.

When investigating a complaint it is good practice to complete all off-site investigations before going onto the site of the alleged dust source. A more focussed investigation once on-site can be provided by collecting as much information as possible from the complainant before entering a site.

The recommended procedure is to do a FIDOL assessment offsite, undertake a 360 degree investigation and then enter the site to determine or confirm that the source of the dust is on the site. While not always practicable (eg, due to terrain), the 360 degree investigation is critical in areas where other sources of dust may be present.

Note: Council officers should note that under section 332 of the RMA, an enforcement officer can only enter a site to investigate if a breach is occurring – not to gather evidence of a confirmed contravention (this requires a search warrant). There will be circumstances where following each step in the procedure is unnecessary. Officers should use their judgement to decide what is appropriate to the circumstances.

When making any contact with site operators/owners, if a council has decided on prosecution, or may prosecute in future, it is good practice for the officer to inform the operator that their statement may be used in evidence.

Council officers should always provide a copy of their report to the site management of the alleged dust source. This allows site management to check the details of the report, note the problem, and make any response necessary. Complainants often want to remain confidential, so this needs to be considered when passing information to site management. Complainants

should be encouraged to be identified and reassured that complaints are a way of gathering information that can help diagnose a problem on site.

Some councils have adopted an approach of carrying out proactive investigations. This involves visiting a site at times when dust is likely to occur, and is based on previous complaint records, weather conditions and/or time of day when dust is more likely to occur. This may be particularly useful in situations where the officer has been having difficulty validating complaints due to response time after a complaint is logged. Usually validation problems are due to changing weather conditions or short-duration dust events. The approach is also useful for determining whether complainants may be being vexatious.

Table 9: Assessment of dust

	I did not find any dust
	I did find dust and consider it would not be objectionable at any location for any duration or frequency
	I did find dust and consider it would not be objectionable, UNLESS it became continuous
	I did find dust and consider it would be objectionable if it occurred on a regular or frequent basis
	I did find dust and consider it would be objectionable even in periods of short duration

Key points

Council officers should follow the complaint investigation and reporting procedures outlined in table 8 to investigate dust complaints.

Complete all beyond-the-boundary observations before going on to the site of the dust source.

4.2.2 Investigating procedures for site workers

Where the site has a resource consent to discharge contaminants to air, good practice is for a condition of the consent to require records of dust complaints be kept, and to investigate and report any dust complaints received. This can be particularly useful if council officers are unable to respond quickly, or complaints come directly to site staff. Similarly, dust management plans often require site personnel to undertake either routine monitoring or *ad hoc* dust investigations.

In all cases, dust investigations by site workers should generally follow the same approach as outlined in table 8. While site staff should still objectively determine whether an adverse effect is occurring, their additional driver will be to undertake a course of action to remedy any identified problem(s).

In responding to dust complaints site workers should:

- be prompt and courteous when talking to the public
- take complaints seriously
- keep in mind that dust effects can be perception based; people's perceptions may be different, but are equally valid.

Key points

Consent holders should:

- take complaints seriously and respond promptly
- keep records of dust complaints
- follow the procedures outlined in table 8 when investigating a complaint or undertaking routine monitoring.

4.3 Monitoring methods

The effects of dust are often assessed and managed qualitatively. However, in some cases ambient monitoring may be undertaken where there may be adverse effects due to the scale of the activity and/or the sensitivity of the receiving. This section introduces the most common particulate monitoring methods.

The three most commonly measured dust parameters are:

- dust deposition
- total suspended particulate (TSP)
- particulate matter of 10 micrometres or less in diameter (PM₁₀).

The key elements of each of these methods are summarised below.

The chosen method should relate to the scale and significance of potential impacts and the sensitivity of the receiving environment. For example, real-time PM₁₀ monitoring may be suitable for high-risk sites, while it may not necessary for a small-scale construction site in a remote area with no sensitive receivers. Similarly, dust deposition monitoring is unlikely to be sufficient for a quarry abutting a residential area. For small-scale sources or sources located in non-sensitive receiving environments, concentrating on good practice dust management measures is likely to be more beneficial than monitoring.

Factors to consider when specifying dust monitoring (in addition to the FIDOL factors) include:

- length of the project/consent
- area and size of the project/consent
- proximity to sensitive receptors
- whether emissions are likely to be constant or variable
- the complexity of the terrain and meteorology.

In all cases where real-time monitoring of TSP or PM₁₀ is to be employed, basic meteorological monitoring should also be undertaken unless a suitable nearby meteorological station already exists.

4.3.1 Dust deposition

Deposited dust is dust that settles out of the air. Measurement is by means of a collection jar or gauge that catches the dust settling over a fixed surface area over a fixed period of time. The dust is removed from the jar, filtered and weighed, and the results are reported in terms of the weight of dust collected per unit of surface area, and over a fixed period of time, eg, g/m²/30 days. Method 10.1: Determination of particulate matter—Deposited matter — Gravimetric method, of AS/NZS 3580.10.1: 2003 (R2014) *Methods for sampling and analysis of ambient air*, is the preferred method for deposited dust monitoring in New Zealand. This method was reviewed in 2014 and reconfirmed as not requiring any update.¹⁸

The equipment used for deposition monitoring typically collects dust particles greater than about 10–20 micrometres, although there is no sharp cut-off in particle size and the collection efficiency is known to vary for different particle sizes.

The deposition gauge method is relatively simple and can provide an indication of long-term trends. It can also be useful for analysis of dust composition. This method has disadvantages including:

- the measurement period is typically one month, and cannot be reduced to anything less than about 15 days without a significant loss in measurement sensitivity. This makes the method unsuitable for the monitoring and control of short-term dust problems
- the wide jar or gauge can be prone to contamination from other sources (eg, bird droppings and leaves).

Deposition gauge dust monitoring is generally not suitable for active site dust management. It may provide some data about the level of soiling nuisance but generally cannot identify the activity creating the nuisance (except where accompanied by source apportionment of dust deposited) or the effectiveness of any on-site dust mitigation techniques, except over very long time periods.

Dust gauges should be carefully sited according to AS/NZS 3580.1.1:2007 *Methods for sampling and analysis of ambient air – Guide to siting air monitoring equipment standard*, having regard to:

- the risk of tampering or vandalism by members of the public
- the impact of nearby structures on wind flow (and thus dust collection efficiency), as required by the monitoring method
- proximity to other local dust sources (such as an unsealed road) that may affect the measurement.

4.3.2 Total suspended particulate

Total suspended particulate (TSP) refers to particles that are suspended in air at the time of sampling. The equipment for TSP measurements is intended to collect all particles, from less than 0.1 micrometres up to about 100 micrometres, although different sampling heads can be used to select specific size fractions.

¹⁸ Many regional councils use ISO/DIS 4222.2 for measuring deposited dust (which differs from the Australia/New Zealand standard in how the dust is sampled and collected). Both the ISO and AS/NZ are accepted methods of sampling.

In the past TSP samples were typically collected using expensive 24-hour high volume samplers. This did not provide immediate information for on-site management, but did provide more current emission levels than the 30-day time period for deposition gauges. Continuous monitors are now available that can collect TSP. These continuous monitors are preferred, as they provide real-time information for active management of on-site activities, while also providing 5-minute, 1-hour and 24-hour average concentrations for comparison with the trigger levels given in [section 3.1](#).

It should be noted that if an activity is likely to have high TSP levels, then, in most circumstances, it is equally likely that PM₁₀ levels may similarly be elevated. If people are reasonably likely to be exposed (ie, neighbouring residential areas), then monitoring for PM₁₀ is recommended instead of TSP. Sites may transition from monitoring TSP to PM₁₀ by running two monitors concurrently for a period of time (ideally a year) before transitioning to a single monitor.

4.3.3 PM₁₀

If it is likely that the PM₁₀ NES will be exceeded then it is good practice to monitor PM₁₀ in accordance with the methods specified in Schedule 2 of the NES for air quality. These methods include:

- United States Code of Federal Regulations, Title 40 – Protection of Environment, Volume 2, Part 50, Appendix J – Reference method for the determination of particulate matter as PM₁₀ in the atmosphere
- Australian/New Zealand Standard AS/NZS 3580.9.6:2003, Methods for sampling and analysis of ambient air – Determination of suspended particulate matter – PM₁₀ high volume sampler with size-selective inlet – Gravimetric method
- Australian Standard AS 3580.9.8:2008, Methods for sampling and analysis of ambient air – Determination of suspended particulate matter – PM₁₀ continuous direct mass method using a tapered element oscillating microbalance analyser
- Australian/New Zealand Standard AS/NZS 3580.9.11:2008, Methods for sampling and analysis of ambient air – Determination of suspended particulate matter – PM₁₀ beta attenuation monitors.

If it is unlikely that the PM₁₀ NESAQ will be exceeded where people may reasonably be exposed, then monitoring may be undertaken employing other techniques or by using screening level equipment which do not comply with the NESAQ Schedule 2 required methods (eg, using a Met One-E-BAM, a low cost beta attenuation monitor).

4.3.4 Other monitoring methods

A variety of other monitoring methods can also be used for assessing dust, including:

Light scattering instruments

Aerosols in the air scatter light in proportion to the amount of particulate in the air. Light scattering, or optical, instruments have traditionally been used for monitoring workplace dust exposures. However, recent technological improvements have seen increasing use of these methods for specific types of ambient air monitoring.

Optical instruments can measure a range of particulates including TSP, PM₁₀, PM_{2.5}, or even PM₁. The units are relatively cheap and portable, and give a direct readout of particle concentrations. These instruments measure the optical properties of particles (which differ from the gravimetric properties of particles), so their accuracy will vary when compared to traditional reference methods. Optical instruments should only be used for compliance monitoring where their limitations are understood and acknowledged.

The main limitation with light-scattering instruments is that the instrument response depends on the properties of the particles such as their colour, shape and reflectivity, rather than the total mass of airborne particulate. Therefore, particulate data obtained from light scattering instruments is not as accurate as that measured by reference methods. Generally speaking, the smaller the particle the more agreement there is between optical and gravimetric based techniques.

This limitation can be overcome to some extent by designing an ambient monitoring programme which allows the difference between an optical and gravimetric data to be quantified. This calibration is essential if comparing measured values with health-based criteria (eg, PM₁₀ NES) but may not be necessary for general dust management purposes. PM₁₀ monitoring requirements set out in the NES and should not be used to assess compliance against the NES.

Research has shown that elevated levels of relative humidity can cause optical monitors to produce artificially high readings (as high humidity can also cause light scattering). For this reason, it is recommended that a temperature/relative humidity controlled heated inlet be used when employing optical instruments to measure ambient particulate.

Time-lapse video

This provides a simple method for visual monitoring of dust-producing activities over extended periods of time. Its main application is in identifying which activities on a site are in need of better dust control. It provides a very strong visual aid for showing on-site staff where the sources of dust are on-site, and how effective dust control is or is not.

Microscopic examination

This can be very useful in investigating complaints of dust fallout. Examination of dust samples under a microscope can often help identify the source. For example, fly ash from a boiler is made up of multi-coloured glass spheres, while dust from a panel beating shop will contain paint fragments. It is also extremely useful in identifying natural dust sources, such as pollen.

The use of scanning electron microscopy has the added benefit of being able to obtain elemental spectra for the particle(s) of interest.

Tracer analysis

Analysis of dust for specific tracer elements can also be useful in identifying dust sources. For example, deposited dust from a secondary steel mill will have high levels of iron and other metals such as lead and zinc.

Directional dust monitoring

Systems are available for linking dust samplers to a wind sensor, so the monitor only operates when the wind is from a certain direction. Alternatively, there are directional dust gauges available in which the dust is collected through vertical slots, which can be lined up with the direction of interest.

4.3.5 Meteorological monitoring

The weather plays a large role in the dispersion of air pollutants and dust. A gentle to moderate breeze (approximately 20 kilometres per hour) can pick up dust particles and deposit them from metres to kilometres away, depending on the size of the particle. In strong winds, these particles can be carried further, and previously deposited material can be re-suspended and transported to a new location (Bay of Plenty Regional Council, 2010).

Where real-time dust monitoring is required, it is recommended that basic meteorological monitoring data is also measured unless a suitable nearby meteorological station already exists. It is important to include meteorological monitoring to ensure that the maximum value and information can be extracted from other air quality or dust monitoring being undertaken to understand the air quality of an area.

The basic level of meteorological monitoring for dust should include the following parameters:

- wind speed
- wind direction
- air temperature
- rainfall.

Monitoring of these additional parameters can provide an improved picture of weather conditions:

- relative humidity
- solar radiation
- temperature profiles at two heights (eg, 3 metres and standard 10 metres above ground level)
- potential evapotranspiration (PET).

Potential evapotranspiration is the rate water (or moisture) is lost from the soil through evaporation and transpiration (in plants). PET can therefore be a useful guide to gauge how much water is required for an area or surface to keep it damp and reduce dust generation.

4.4 Quantitative assessment

Quantitative assessments may be either screening or detailed (refer *Good Practice Guide for Assessing Discharges to Air from Industry*, Ministry for the Environment, 2016b).

Dispersion modelling is typically only employed for new, large industrial sources of particulate. This is because it can be very difficult to estimate and model particulate emissions accurately, particularly from fugitive sources. Methods to estimate dust emissions are described in [section 4.4.2](#).

In the majority of cases (existing industrial sources, large open area sources), it is usually more appropriate to focus on methods to control the dust at the source instead.

4.4.1 Dispersion modelling

Dispersion modelling predicts the concentration of particulate matter downwind of the source using computer programmes. Modelling inputs include the:

- characteristics of the discharge
- local terrain heights
- meteorological conditions
- locations of downwind receptors
- particulate emission rates (most importantly).

Gaussian models are used for simple assessments and more sophisticated models (eg, The Air Pollution Model (TAPM), Calpuff) may be required for complex activities or for locations involving complex terrain or other confounding factors.

Detailed guidance on dispersion modelling is provided in the [Good Practice Guide for Atmospheric Dispersion Modelling](#) (Ministry for the Environment, 2004).

Dispersion modelling is not generally recommended for use with area dust sources (eg, unpaved surfaces) or fugitive dust sources (eg, stockpiles). Modelling such sources can be complex and needs to take into account the emission rate (which often varies), the size distribution of the dust particles (which is often not available), and the possible variations in deposition rates.

Modelling of dust from area and fugitive dust sources may be appropriate to assess proposed new large facilities such as open cast mines. This type of source modelling is complex and should only be undertaken by specialists in dispersion modelling. It is also very important that a clear and transparent methodology is used, and any limitations in the modelling are acknowledged and accounted for when analysing the results.

4.4.2 Estimating dust emissions

The two most commonly used methods of determining particulate emissions from a process or activity are:

- direct measurement by emission testing, and/or
- estimation using published emission factors.

Emission testing is of limited use for non-point source discharges, because fugitive dust emissions are very difficult to measure¹⁹. Emission testing is also only possible for existing processes.

Because of this, the most common approach for fugitive dust assessments is emission estimation using published emission factors. Caution needs to be taken that any differences between activities are highlighted and any resulting inferences relating to the data are explained in detail. The most widely used and extensive data on emission factors are published

¹⁹ [Section 4.3](#) outlines measurement for dust effects downwind.

by the United States Environmental Protection Agency (known as AP-42)²⁰ and the Australian Ministry for the Environment.²¹ Some of the dust sources covered in these documents include:

- paved and unpaved roads
- heavy construction activities
- aggregate handling and storage piles
- open area wind erosion
- surface coal mining
- sand and gravel processing
- abrasive blasting
- various forms of mineral processing.

The emission factors given in AP-42 are based on measurements of a number of different sources, under varying operating conditions. The factors are usually expressed in terms of the mass emission expected for a specific processing rate (eg, grams of pollutant per tonne of raw material used). The total emissions are then estimated by multiplying the expected activity rate (eg, plant processing rate by the relevant factor). Each of the emission factors is assigned a quality rating from A (excellent) to E (poor), which indicates how good a factor is, based on both the quality of the test(s) or information that is the source of the factor and on how well the factor represents the emission source.

Emissions estimates of fugitive dusts can be inaccurate, because the sources are often diffuse, intermittent, and variable. Many of the emission factors are also for particles smaller than 30 µm, which only covers a fraction of the particles that can be emitted as nuisance dust. Therefore, use emissions factors with caution, taking into account their reliability and the purpose they have been developed for. Any assumptions that form part of the calculations should be clearly stated.

Key points

Modelling of dust emissions from area and fugitive sources is not generally recommended.

In situations where good quality data is not available it may be more appropriate to focus on methods to control the dust at source instead.

4.5 Background levels

General dust deposition levels measured in New Zealand range from about 1–4 g/m²/30 days. Background concentrations are usually less than 1 g/m²/30 days, but there are also areas (such as Central Otago) where the natural dust levels can be up to 10 times this amount. Measurements in the vicinity of specific industrial sources are commonly in the range of 4–8 g/m²/30 days, but can be as high as 10–20 g/m²/30 days in extreme cases. The industries include timber mills, quarries, mines, steel mills, and port operations, with the highest results being recorded alongside abrasive blasting operations.

²⁰ US EPA Compilation of Air Pollutant Emission Factors, AP-42.

²¹ Australian National Pollutant Inventory Emission Estimation Technique Manuals.

There is only a limited amount of data available on TSP levels around the country, as much of this type of monitoring is now directed toward the finer fraction, PM₁₀ which cause greater health impacts. Background TSP levels in clean environments are about 10–20 µg/m³. Levels of about 30–60 µg/m³ have been reported for general urban areas, and about 50–100 µg/m³ for general industrial areas, such as Penrose in Auckland and Hornby in Christchurch. Levels of up to 300 µg/m³ have been recorded near some specific industrial sources (eg, a scrap metal yard), but these are relatively extreme events. Some resource consents have requirements for TSP monitoring. Information about this is available from the relevant council.

People wanting to carry out activities should consult with their local unitary or regional council to determine whether there is any local monitoring data available. Local data can be useful to determine background levels, and in some instances can be used to infer effects from similar activities.

For PM₁₀, monitoring data is available from all regional councils either available on their website or on request. Current air quality data can be found on the [Land, Air, Water, Aotearoa website](#). This information is helpful in determining whether the PM₁₀ NES is likely to be breached either with, or without, the activity. If an airshed is already non-compliant with the PM₁₀ NESAQ then consultation with the regional/unitary council is imperative. Further information on complying with the PM₁₀ standard can be found in the Ministry's 2014 update of the *2011 Users' Guide to the revised National Environmental Standards for Air Quality: Updated 2014* (Ministry for the Environment, 2014) and the associated *Clean Healthy Air for All New Zealanders: The National Air Quality Compliance Strategy* (Ministry for the Environment, 2011).

5 Management and control of dust emissions

This section of the guide outlines good practice management and control of dust emissions. In doing so, no distinction is made between the different size fractions of dust emissions. This is because management and control of larger size fractions (ie, deposited dust and TSP) will, at the same time, manage and control smaller size fractions (ie, PM₁₀ and PM_{2.5}).

This is supported by case studies (refer [section 5.3](#)) that repeatedly show that effective control of visible dust helps maintain ambient levels of PM₁₀ below the PM₁₀ NES.

5.1 Management options for regulators

Regulators manage dust emissions through policies and rules in regional and district plans. The rules typically specify those discharges that are permitted (usually subject to certain conditions), and those that require a resource consent. Monitoring and responses to dust complaints also play a significant role in managing potential dust impacts of existing activities. The options available to regulators are largely provided under the Resource Management Act (RMA), as discussed in [section 1.2](#). Resource consents may be granted subject to conditions.

5.1.1 Separation distances

Separation distances (buffers) are primarily intended to manage:

- the effects of unintended or accidental discharges
- the adverse effects of activities that cannot always be adequately avoided, remedied or mitigated without a separation distance, even with the adoption of best practice (for example, large quarries)
- reverse sensitivity effects (discussed in [section 5.1.2](#) below).

Separation distances are not intended as an alternative to source control. Instead they are implemented in addition to pollution controls that are consistent with the best practicable option.

Maintenance of appropriate separation distances is primarily a land-use planning issue that is managed through district plan provisions, which may include:

- appropriate location of industry within an area that is zoned for industry in the district plan and is adequately separated from more sensitive zones, with provisions to exclude sensitive activities from the buffer area.
- graduated zoning in from heavy industry through to light industry, to highly sensitive land uses such as residential. Councils have to balance this against making sure that the availability of industrially zoned land is not eroded over time
- creation of zones and zone provisions (or other planning provisions, such as overlays) that alert prospective owners, developers and decision-makers to the potential for reverse sensitivity effects if new sensitive activities are established in particular locations.

Regional and district plans can also include buffer distances to determine activity status (eg, the Auckland Operative Air, Land and Water plan provides that quarries are a controlled activity within a separation distance of 200 metres from any dwelling).

Auckland Council published a review of separation distances applied across Australasia in 2012 (Emission Impossible Ltd, 2012). At time of writing, EPA Victoria has the most up-to-date guidance considered appropriate for New Zealand (EPA Victoria, 2013).

When considering an appropriate separation distance for a site, the assessor should always review the relevant guidance and ensure the basis of the recommended separation distance is clearly understood.

Key point

Relevant separation distances should be considered when assessing discharges to air to address unintended or accidental releases, and/or effects that cannot be internalised even with adoption of the best practicable option.

5.1.2 Reverse sensitivity

Reverse sensitivity occurs when sensitive activities, such as residential properties, are allowed to locate where they may be adversely affected by industrial or noxious activities. This has the adverse effect of limiting the ability of the heavy industry or noxious activity to operate efficiently and with long-term certainty. Allowing sensitive activities to establish in close proximity to industry can have adverse effects on the health, safety or amenity values of people, as well as potentially adversely affecting the economic and safe operations of activities.

A number of regional and district plans include provisions to manage the effects of reverse sensitivity, for example by restricting the establishment of sensitive activities in certain zones. However, reverse sensitivity effects may continue to arise depending on land-use planning decisions. For individual sites that are not protected from the effects of reverse sensitivity through plan requirements, and cannot feasibly 'internalise' their effects, maintenance of an appropriate separation distance is the main option to manage reverse sensitivity effects.

It should be noted that all plan changes must meet the purpose of the RMA. Additionally, the overriding duty in section 17 of the RMA still applies, ie, all activities still hold an obligation to avoid, remedy or mitigate adverse effects and contain adverse effects within their own sites. All zone changes, for example to allow a subdivision, must be considered an efficient use of land, and should not challenge amenity values, such that there insufficient land available in the district for rural-residential development.

5.1.3 Term of consent

While the RMA provides for maximum terms of consents, it is silent on the specific considerations a council must or may turn to when deciding on the duration of consents. While the council has discretion, the council may wish to consider the following when granting shorter terms of consents (in this case 15 years). Specifically, a shorter consent may apply if the activity:

- is one which generates fluctuating or variable effects, or
- depends on human intervention or management for maintaining satisfactory performance, or
- relies on standards that have altered in the past and may be expected to change again in future.

It should be noted that the term of consent, and the ability of a consent authority to review conditions of consent, provide different safeguards.

5.1.4 Monitoring and enforcement

Local authorities are required to monitor, respond to, and keep records of complaints to effectively carry out their functions under the RMA. The ultimate action a council takes will depend on the policy of the individual council, the history of the site, the degree of adverse effect and how much co-operation there is from the discharger.

Enforcement action is usually the last resort. In the first instance it is usually desirable to resolve the situation either with the discharger or the council (see [section 5.2.12](#) for more detail). Enforcement action is generally straightforward for acute effects or where the discharger has clearly been negligent. In other cases, it is more appropriate to provide a warning and allow the discharger time to rectify problems.

If there are repeated valid complaints and non-co-operation, a council should consider proactive monitoring, which includes instrumental monitoring and involves visiting a site frequently over a short period of time, at times when dust is expected to occur (eg, when the wind picks up). This has the effect of building a better picture over a shorter timeframe, and provides the ability to take appropriate action more quickly than would otherwise be possible. Sometimes the action may be to do nothing, because the council has not substantiated any dust problems and more resources are not justified.

Where a problem is acknowledged by a discharger, community liaison can be useful to work through a solution and negotiate timeframes that are realistic for all parties. If timeframes are not met, councils should consider enforcement action.

For controlling non-consented activities giving rise to dust issues (eg, unpaved sites, ploughing of fields) that are not subject to a rule in a regional plan, the enforcement measures available to the council include issuing an abatement notice under section 17 of the RMA. However, this gives the offender seven days to comply, which is not ideal if the effect will only last a few hours or even days.

Where a community is not satisfied with the actions of the council and/or the discharger, common law actions are available.

Key point

Proactive monitoring, including instrumental monitoring, is recommended when dust is prolonged or recurring.

5.2 Management options for industry

The starting point for effective dust management is to build a positive relationship with the community affected by the dust, as discussed in [section 1.4](#). This will help with communication, as well as determining key concerns, and deciding and prioritising any mitigation. Early community consultation may also avoid the need to undertake the detailed assessments and methods discussed in [section 4](#).

The remaining section outlines mitigation options for avoiding, reducing and managing dust at a specific site. The dischargers who create adverse effects should confine them as far as possible to the site where the activities giving rise to those effects are carried out. The appropriate mitigation method depends on the site and process requirements, and a combination of approaches might be used to reduce dust, or the potential for nuisance dust effects. Factors for determining the appropriate solution include the nature of the dust, the characteristics of the source, and the control efficiency required. Assessment of the controls needed must consider both normal and abnormal conditions. In many cases a high level of specialist engineering input is required to develop the most appropriate solution.

5.2.1 Site design and management

Site planning is the first consideration for all dust sources, particularly those that are diffuse and can be difficult to manage, such as earthworks and quarrying. The following issues should be considered:

- designated land use of the site and the surrounding land under the district plan
- location of dust sources within the site and their orientation in relation to prevailing winds and sensitivity of the downwind receptors
- presence of separation distances to the site boundary and to sensitive land uses
- need for screening, such as by shelter belts, earth bunds or natural topography.

The second consideration is good site design and operating procedures. These can help prevent and minimise dust problems, and even avoid or reduce the need for 'end-of-pipe' controls in some cases. The design should consider:

- raw materials
- flow of materials and vehicles through the site
- waste handling
- processing plant
- instrumentation and control
- plant buildings.

It is essential to:

- (where practicable) ensure dust sources are adequately enclosed and that equipment is accessible for maintenance and cleaning
- implement a preventative maintenance programme to minimise equipment failure and unplanned downtime
- take dust management seriously – educate staff about the importance of regulatory compliance and good management for achieving compliance

- have a regime of good housekeeping
- conduct dusty operations during weather conditions that minimise emissions wherever possible, particularly where no other mitigation option is available (eg, avoid windy dry weather days for ground stripping).

For most sites, effective dust control will usually only be achieved through good site management and by ensuring that the appropriate operational procedures are in place. The operational procedures should also include a preventative maintenance programme, and contingency measures to minimise equipment failure and unplanned downtime. These procedures and the effects that they mitigate should be clearly described in a site/dust/construction management plan for the site. Staff responsible for implementing the management plan should be clearly identified.

An outline of what to include in a dust management plan is given in [Appendix 4](#), but should include the following matters as a minimum:

- what has to be done, and why
- who has to do it and/or see that it is done
- how it will be done
- the desired outcomes
- how these outcomes will be monitored.

The contents of the plan should also be subject to regular review.

The New Zealand Transport Agency's [Construction air quality management plan template](#) is a good practice example of a construction management plan that comprehensively addresses dust.

5.2.2 Paved surfaces

Dust deposits on paved surfaces can be thrown into the air by wind or by vehicle movements. Dust pick-up by wind is usually only significant at wind speeds above 5 metres per second (10 knots), but vehicle re-entrainment can occur under any condition.

Dust emissions from paved surfaces can be minimised through the following procedures:

- controlling the movement and handling of fine materials to prevent spillages onto paved surfaces
- minimising mud and dust track-out from unpaved areas by using rumble strips or wheel and vehicle wash facilities
- regularly cleaning paved surfaces, using a mobile vacuum sweeper or a water flushing system
- covering dusty loads to prevent spillage onto paved surfaces
- speed controls on vehicle movements (see [section 5.2.4](#))
- wind reduction controls (see [section 5.2.8](#)).

Note that paving a surface is a dust mitigation method in itself, provided the above procedures are observed. Dust emissions from paved surfaces can be reduced by 90 per cent or more, but this is highly dependent on these procedures being applied rigorously and consistently.

5.2.3 Unpaved surfaces

Dust emissions from unpaved surfaces, including unsealed roads, are caused by the same factors as for paved surfaces, but the potential dust emissions are usually much greater. Dust emissions can be controlled using the following procedures:

- Wet suppression of unpaved areas should be applied during dry windy periods, using a water cart and/or fixed sprinklers. As a very general rule of thumb, the typical water requirements for most parts of New Zealand are up to 1 litre per square metre per hour. It is important to check that the available water supplies and the application equipment are able to meet this requirement. For larger sites or those with a limited water supply, undertaking an assessment of the dust suppression water demand and supply is highly recommended.

Figure 4: Water truck operating on an unsealed surface at a timber yard



- Chemical stabilisation, such as polymer additives, can also be used in conjunction with wet suppression. This involves the use of chemical additives with minimal water (as little as 0.1 per cent moisture addition with dry fog suppression systems), which help to form a crust on the surface and bind the dust particles together through particle agglomeration. Chemical stabilisation reduces watering requirements, but any savings are likely to be offset by the cost of the additives. The general consensus is that chemical additives can be successful, but they are costly and do not last long. Issues to watch out for:
 - runoff and water contamination
 - surface preparation plays an important role in how the chemical additives bind to the dust particles, and therefore needs to be taken into consideration.

Note: Good practice is for chemical additives to be shown to have no adverse effects on the environment. Waste oil has been used historically but is prohibited by most regional plans and not suitable for this purpose.

- Re-vegetation of exposed surfaces. This should be done wherever practicable at mine, quarry and construction sites, and other similar activities subject to ongoing development. Techniques such as hydro-seeding and the use of geotextiles should be used on sloping ground and other difficult surfaces.

- Surface improvements. These include paving with concrete, asphalt or cobbles (for sites requiring hard-wearing surface for example, log yards), or the addition of gravel or slag to the surface. Paving can be highly effective, but is expensive and unsuitable for surfaces used by very heavy vehicles or subject to spillages of material in transport. In addition, dust control measures will usually still be required on the paved surfaces. The use of gravel or slag can be moderately effective, but repeated additions will usually be required.
- Speed controls on vehicle movements (see [section 5.2.4](#)).
- Wind reduction controls (see [section 5.2.8](#)).

Unpaved surfaces can be a significant cause of dust problems on adjacent paved surfaces (eg, roads) if there is no control over carry-out of mud and dirt. This can be controlled by the use of wheel wash facilities.

Wet suppression of unpaved areas can achieve dust emission reductions of about 70 per cent or more, and this can sometimes be increased up to 95 per cent through the use of chemical stabilisation. Re-vegetation and paving can achieve up to 100 per cent control efficiencies, but have only limited application.

5.2.4 Vehicles

Vehicles travelling over paved or unpaved surfaces tend to pulverise any surface particles and other debris. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents due to turbulent shear between the wheels and the surface. Dust particles are also sucked into the turbulent wake created behind the moving vehicles.

The loads carried by trucks are a potential source of dust, either through wind entrainment or spillages. Mud and dust carry-out from unpaved surfaces is another potential problem.

Dust emissions due to vehicles can be minimised with the following controls:

- limiting vehicle speeds. Industrial sites in New Zealand commonly apply a speed limit of 10–15 kilometres per hour. Additional speed control measures such as judder bars (speed humps) are used along with a speed limit
- limiting load size to avoid spillages
- covering loads with tarpaulins or the use of enclosed bins (to prevent dust re entrainment from trucks)
- minimising travel distances through appropriate site layout and design
- using wheel and truck wash facilities at site exits.

Speed controls on vehicles have an approximately linear effect on dust emissions. This means that a speed reduction from 30 to 15 kilometres per hour will achieve about a 50 per cent reduction in dust emissions.

5.2.5 Material stockpiles

Fine material stored in stockpiles can be subject to dust pick-up at winds in excess of about 5 m/sec (10 knots). Dust emissions can also occur as material is dropped onto the stockpile. The options for dust control include:

- Wet suppression using sprinklers.
- Grass and/or chemical suppressants for inactive stockpiles.

- Covered storage of fine material. This should be considered for use in high sensitivity locations, and for storage of finely divided material with a high dust potential, such as fertiliser, coal, gypsum and other industrial minerals.
- Limiting the height and slope of the stockpiles can reduce wind entrainment. For example, a flat shallow stockpile will be subject to less wind turbulence than one with a tall conical shape. Consideration should also be given to the effect of other site features. For example, it may be possible to reduce wind effects by keeping the stockpile heights below the level of the site noise bund.
- Limiting drop heights from conveyors, loaders or other equipment transferring material to and from stockpiles.
- Wind breaks (see [section 5.2.8](#)) – wind speed near the pile surface is the primary factor affecting particle uptake from stockpiles.
- Bunding (eg, concrete bunding) can be very effective in controlling dust from stockpiles provided that the bunds are located facing away from the prevailing wind direction and that the bund walls are at least one third higher than the maximum height of the stockpile. If the stockpile gets to the top of the bunds the efficacy of the bunding is significantly reduced.
- Storage silos – some types of dust (such as cement and flour) are very fine, they may also be combustible. These materials should be stored within silos, which often require their own dust control measures (such as baghouses) to ensure that the dust is contained. The pneumatic filling of silos can cause displaced air to be discharged, so all silos must have filters fitted to avoid dust emissions from this displacement.

5.2.6 Conveyors

Dust emissions from conveyors can be caused by wind pick up, and through losses during loading, discharge, and at transfer points. The following options should be considered for minimising dust pick up from conveyors:

- use of enclosed conveyors for fine material
- use of water sprays or sprinklers, or enclosures at conveyor transfer points
- minimising drop heights at transfer points, including use of conveyors that can be raised and lowered
- regular clean up of spillages around the transfer points and any other places where this might occur.

5.2.7 Material handling

Materials handling, using front-end loaders or mechanical grabs, is another potential source of dust emissions. These mainly occur when the load is dropped into a truck or hopper, but can also be caused by spillages during handling.

These problems are best addressed by minimising drop heights, and regular clean up of any spillages. In some cases (such as wharves or irregular surfaces), covering of the potential spill areas may be necessary to aid clean up. Regular maintenance of hydraulic grabs is important to ensure complete closure. Hopper load systems should be designed to ensure a good match with truck size, and should be fully enclosed on the sides.

5.2.8 Wind protection

Wind is a major cause of dust emissions from many sites. The effects can be partially mitigated through the use of shelterbelts, wind breaks or temporary screening. It may also be possible to make use of natural land features, or artificial features such as noise bunds, to provide a degree of wind protection. This option should be considered in the initial development of the site layout and design.

Windbreaks are almost as effective as a solid wall in reducing wind speeds, when constructed to the following specifications:

- height equal or greater than the pile height
- length equal to the pile length at the base
- located at a distance of one pile height from the base of the pile.

Wind breaks can be constructed using horticultural cloth supported on poles, or by planting trees. Some of the species commonly used for this purpose include casuarina, cryptomeria and some variety of cupressus. Professional horticultural advice should be sought regarding suitable species for any specific site.

5.2.9 Fixed plant

Fixed plant includes equipment such as crushers, shredders, driers, and other processing equipment. These are point sources of dust emissions, which should be controlled using standard equipment such as cyclones, wet scrubbers, and fabric filters. There is also potential for fugitive emissions from this type of plant, which should be controlled using:

- locating the fixed plant to provide maximum separation distances between it and any sensitive receptor
- minimising of drop heights into hoppers and loading chutes
- sprinklers or water sprays around hoppers and other transfer points
- hooding or enclosure of significant fugitive sources, with the emissions being ducted to bag filters or other dust control equipment
- operating the fixed plant at times when meteorological conditions are not conducive to producing large dust plumes.

Fixed dust control systems can achieve control efficiencies ranging from about 70 per cent for cyclones, and up to 95 per cent or more for bag filters.

5.2.10 Mobile abrasive blasting

Dust from abrasive blasting in fixed installations is normally controlled using enclosed equipment fitted with dust extraction systems. However, the dust emissions from mobile units are harder to control because it may not be practical for the operation to be fully enclosed. Some options for dust control on mobile abrasive blasting include:

- partial enclosure of the work area using plastic or cloth sheeting
- use of synthetic blasting materials that generate less or no dust (eg, synthetic carbides, plastic media, and sodium carbonate)

- use of vacuum blasters, in which the blast nozzle is surrounded by a vacuum extraction system
- wet blasting or use of a water curtain system around the edges of the structure.

The use of these methods can reduce dust emissions by 50–95 per cent. Take care to observe other general precautions, such as the use of wind protection, or only spraying under certain weather conditions.

Precautions are also necessary where the blasting is of material containing heavy metals (such as copper in paint). In these situations, blasting should be internalised within the site and the spent material should be collected as soon as practicable to prevent the accumulated material becoming airborne, and avoid causing secondary issues (such as contaminating water).

5.2.11 Meteorological monitoring

Continuous monitoring of wind conditions is recommended when dusty activities are to be carried out in a sensitive location. Local meteorological data is critical for investigating off-site dust complaints, and there are a variety of low-cost monitoring options now widely available. These can be installed with telemetry to provide alarms when trigger levels (eg, winds above 5 m/sec) are exceeded. They can also be used as a signal for work to cease (eg, winds above 10 m/sec).

5.2.12 Community consultation and negotiated solutions

The first rule for any activity that involves discharging dust is to be considerate to your neighbours. Communicating with the local community is important for building good relationships and trust, which are a useful foundation for times when dust problems do occur. It is important to bring the community on side as part of the problem-solving process, both to help identify where problems lie and to negotiate solutions, including timeframes for implementation.

Abnormal dust events can occur without warning, or may be from planned maintenance. Letting people surrounding the site know about such events as early as possible helps reduce annoyance in the community. The discharger should also inform people about what is being done to remedy the problem, and to prevent its recurrence, and how long the problem will take to fix. The level of annoyance may reduce if people see that the discharger is genuinely addressing adverse effects in a proactive manner.

Methods for communication include public meetings, community working parties, mail drops, and a phone line for complaints and enquiries.

If the site is well operated and having very little impact, it may be difficult to get people to attend a community meeting. In these cases a less formal approach, such as an annual barbecue, can provide a useful opportunity for community feedback.

The importance and benefits of open, honest communication cannot be overstated.

5.3 Case studies

CASE STUDY: DUST MANAGEMENT IN NGĀPUNA

Air quality monitoring in Rotorua recorded high concentrations of particulate matter at the Ngāpuna monitoring site. The concentrations were recorded during the weekday afternoons in spring and summer, which indicated that the source was not related to home heating. Bay of Plenty Regional Council (BOPRC) conducted a detailed investigation to identify the specific sources of dust.

The investigation concluded that various industrial and commercial activities and sites in the Ngāpuna industrial area cumulatively caused the dust issue in Ngāpuna (Bay of Plenty Regional Council, 2010). Specifically, BOPRC found that the primary causes of Ngāpuna's exceedances were due to industrial yard and process dust, and road dust picked up by the wind (south-westerlies) after a period of dry weather. To address this, BOPRC developed the Ngāpuna Dust Reduction Operational Plan.

The Ngāpuna Dust Reduction Operational Plan adopted a three-stage education-enforcement approach, as shown in table 10 (Bay of Plenty Regional Council, 2012).

- Stage 1 aimed to raise awareness of the dust issue, and target each source of dust with specific actions to voluntarily reduce emissions. Site-specific dust management plans were developed (or updated) for each site in the Ngāpuna area, following consultation with the site. Each plan contained some general terms (such as increased sweeping or implementing on-site speed limits) and recommendations in line with Council's staged approach, while also including site-specific details.
- Stage 2 involved the use of enforcement tools, such as complaint investigations and written warnings for offenders. This stage adopted light-handed enforcement without significant penalties being imposed.
- Stage 3 included active enforcement options, such as infringement notices and prosecutions for sites with ongoing dust incidents.

Table 10: Implementation timeline of the Ngāpuna Dust Reduction Operational Plan

Stage one Awareness raising and voluntary reductions 2011/12	Stage two Light-handed enforcement and information 2012/13	Stage three Active enforcement and information 2013/14
Dust management plans consulted on and drafted	Dust management plan implementation by industries	
Additional road sweeping investigated	Road sweeping frequency and coverage increased	
Develop communication plan	Implementation of communication plan	
Co-operation with agricultural landowners	Light-handed enforcement	Active enforcement
		Plan review

CASE STUDY: DUST MANAGEMENT IN NGĀPUNA

Bay of Plenty Regional Council found that most sites in the Ngāpuna area were cooperative and voluntarily made changes to their dust management practices. This was primarily due to the collective approach employed by BOPRC which engaged all sites in Ngāpuna (rather than singling out individual sites). An independent audit also supported the plan, along with feedback to all sites on progress at regular intervals.

The plan has been successful – there have been no recorded PM₁₀ breaches at the Ngāpuna monitoring site since November 2011.

Figure 5: Dust generated at an unsealed carpark in Ngāpuna



CASE STUDY: DUST AUDIT MACKAYS TO PEKA PEKA PROJECT

The Mackays to Peka Peka Alliance (M2PP) identified a risk around dust being generated from the project's activities (mainly from wind erosion of exposed sand), which would impact on nearby residents and result in non-compliance of the activities on site.

To gauge whether the site and dust management plans were sufficient to cope with the level of activity on site, M2PP commissioned an independent review (audit) of their dust management practices. M2PP identified specific questions to be answered in the review, which included:

- whether there was enough water available and the means to distribute it to the site to control dust for a worst-case scenario (eg, prolonged drought conditions)
- whether all bores originally proposed had been sunk, and if not, were there any limits to water availability and the means to distribute it to affected areas
- what the limiting factors were (such as the number of water carts available, the distances travelled, the means to distribute the water to areas subject to wind erosion)
- whether the proposed response was possible 24 hours seven days a week, and what the potential limitations to this were (eg, noise or traffic restrictions)
- what were the soil moisture requirements for minimising wind erosion on sand hills
- whether adequate consideration was given for other means of dust control, such as sprinkler systems, dust fences, or stabilisation agents along high-risk areas
- whether appropriate planning was undertaken to ensure a suite of responses were available for immediate implementation
- if dust control measures had been communicated and understood by key staff, and whether the construction teams were aware of requirements and proactive in their planning whether the M2PP environmental team were taking appropriate steps to monitor compliance with the requirements of consent, and what were the actions from these results.

Appendix 1: Dust assessment criteria

The following matters should be considered by councils when determining whether a dust discharge has caused an objectionable or offensive effect. It will not be necessary to consider all the listed matters in items 2 to 10 in every case.

- 1) In all cases councils should consider the:
 - **frequency** of dust nuisance events
 - **intensity** of events, as indicated by dust quantity and the degree of nuisance
 - **duration** of each dust nuisance event
 - **offensiveness** of the discharge, having regard to the nature of the dust
 - **location** of the dust nuisance, having regard to the sensitivity of the receiving environment.

Assessment will be based on the combined impact of these factors, determined from some or all of the following sources.

- 2) Other validated dust complaints or events relating to discharges from the same site, including previous validated complaints from one location.
- 3) Collection of dust samples and analysis to identify the source (where necessary and appropriate).
- 4) Weather conditions at the time of the dust event, notably wind speed, wind direction and rainfall.
- 5) Information regarding process conditions that may have caused the complaint. The effectiveness of dust control measures at the site should be taken into account.
- 6) A complaints register held at the site. Councils may require the discharger to keep such a register and identify any cause of an alleged dust nuisance, including remedial action taken.
- 7) Dust monitoring both within and beyond the site boundary. This includes both deposited dust and suspended particulate monitoring.
- 8) Results of dust deposition modelling carried out as part of an assessment of effects. These results may be compared to the trigger levels. Note that this method will have limited application to dispersed area sources or small-scale discharges. Its primary value lies in the prediction of the effects of point source dust discharges, such as stacks.
- 9) Contents of dust diaries held by people living and working in the affected area. People may be requested to keep such a diary. The diaries would record details of any dust nuisance event, including the date and time of the event, weather conditions at that time (wind speed and direction, rainfall), a description of the type and amount of the dust detected, and the duration of the dust event.
- 10) Results of a public survey or field investigation commissioned by the council or the discharger. In this case it is critical that the survey or investigation is professionally designed, to ensure that credible and reliable information is gathered.

Explanatory note

The extent of dust nuisance should be determined from all available evidence relating to one or more dust events. In most cases the information specified in items 7–10 (dust monitoring, diaries and public surveys) will not be necessary. Ideally, the discharger will implement good practice dust control measures to remedy noxious, dangerous, objectionable or offensive effects, without the need for expensive investigation. For large-scale discharges with potential for significant nuisance, or where enforcement action is likely to be required, some or all of the techniques discussed in items 7–10 may be required.

Appendix 2: Dust diary record sheet

The following page is an example dust diary record sheet.

Definitions

Objectionable The term objectionable is the term used in consent conditions and is an ingredient of any subsequent enforcement action. It is a subjective term and is open to interpretation. There is guidance from case law which defines objectionable as: unpleasant or offensive or repugnant; open to objection or undesirable or disapproved of; noxious or dangerous. A test will be applied by the court that the term objectionable will be as it applies to ‘the minds of a significant cross section of reasonable people in the community’. The assessor must bear this test in mind when completing their assessment.

Intensity The concentration of dust (2 = light sprinkling of dust particles, 5 = thick coating of dust)

Character Type of dust (eg, black coal dust)

Scale of intensity

6	Extremely heavy
5	Very heavy
4	Heavy
3	Distinct
2	Light
1	Very light
0	No dust

Land Beaufort Wind Scale

B. No.	Description	How to recognise
0	Calm	Smoke rises straight up
1	Light air	Smoke drifts
2	Light breeze	Wind felt on face; leaves rustle
3	Gentle breeze	Flags flap; twigs move all the time
4	Moderate breeze	Papers blow; small branches move
5	Fresh breeze	Small trees sway
6	Strong breeze	Large branches move, wind whistles
7	Nearg	Whole trees sway

Measuring cloud cover

Okta No.	Description
0	Clear sky
1	Sunny
2	Mostly sunny
3	
4	Half the sky is covered in cloud
5	
6	Mostly cloudy
7	Considerable cloudiness
8	Overcast
F	Fog / Mist

During the day the sun is always shining, so the amount of sunshine reaching the ground depends on the amount and duration of any cloud cover. The amount of cloud cover is usually given in units called oktas. Each okta represents one eighth of the sky covered by cloud.

Appendix 3: Complaint investigation form

These are modified from odour complaint forms courtesy of Greater Wellington Regional Council and Environment Canterbury.

DUST COMPLAINT & ASSESSMENT FORM

PART A: Complaint Details

Date: _____	Time: _____	Complaint Received By: _____
Name: _____		Address: _____
Contact phone numbers: _____		Possible source: _____
Anonymous: Y/N _____		Is dust occurring now? _____

Complaint details (include impacts/effects experienced by complainant): _____

PART B: Complainant Location Assessment

Date: _____	Time: _____	Assessors Name: _____
Person spoken to at complaint location: _____		Reason for investigation: COMPLAINT/PROACTIVE

Complaint details (include impacts/effects experienced by complainant): _____

INITIAL IMPRESSIONS:

Time of the initial impression: _____	Type of dust: _____
Any visible dust deposits: Y/N _____	Plume width (if known): _____

VISIBLE DUST DEPOSITS
Describe approximate quantities and extent

When was surface last cleaned? _____	Frequency of cleaning: _____
--------------------------------------	------------------------------

Describe the appearance of the deposits:

Colour _____	Any odour _____
Shape _____	Water soluble _____
Size _____	Other _____
Crystalline or powdery _____	
Hard, soft _____	

Weather Data (see over)

Wind direction: _____
Wind velocity: _____
Cloud cover: _____
Temperature: _____
Rainfall in past 24 hrs: _____

Photos Taken: Y/N _____ Samples taken Y/N _____
Diagram/description of where photos were taken.

Diagram/description of where samples were taken:

Sample collection: Use a small paintbrush (clean) to sweep samples of the dust onto a sheet of paper and then into a clean plastic bag. At least half a teaspoonful will be required for analysis. Lesser amounts may be collected on strips of clear cello tape, which should then be stuck onto sheets of clear plastic to preserve the samples. Label all samples and record date, time, location, etc on a separate sheet of paper if required.

Based on your assessment on this occasion, which of the following applies:

- I did not find any dust
- I did find dust and consider it would not be objectionable at any location for any duration or frequency
- I did find dust and consider it would be objectionable if it became continuous
- I did find dust and consider it would be objectionable if it occurred on a regular or frequent basis
- I did detect dust and consider it to be objectionable even in periods of short duration.

FINAL CHECKLIST

- Upwind assessment completed. Record details below. If not, detail reason: _____
- Aerial photo/sketch showing location of assessment and upwind assessment attached
- Are there potential witness statements to obtain YES/NO

REMARKS

PART C: Off-site dust and 360° assessment

Assess the dust upwind of the suspected source and if possible conduct a 360° sweep around the source assessing the odour at different points

OTHER POTENTIAL SOURCES

Check for road works, ploughing, construction activities, burn-offs, unsealed roads, unsealed sites

Time: _____

Site 1:

Wind direction: _____ Wind strength: _____ Wind stability: _____ GPS Loc: _____
Visible dust: _____ Description of dust: _____
Comment: _____

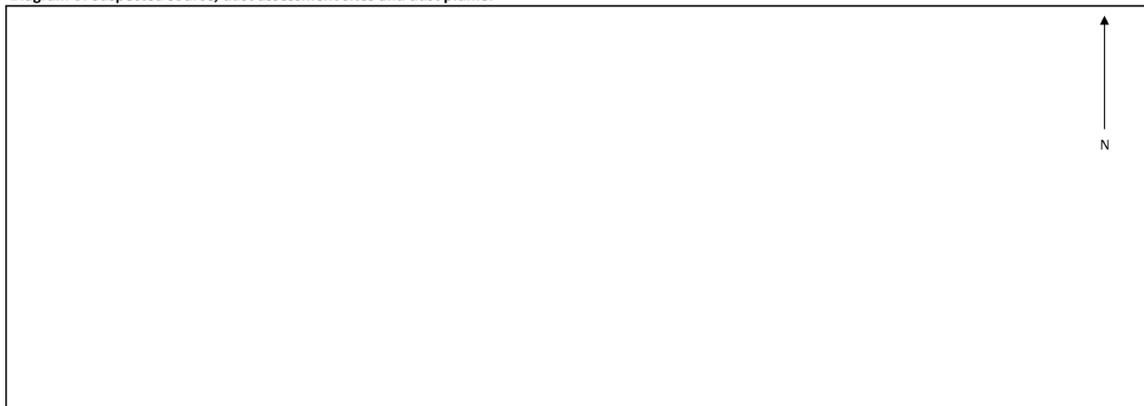
Site 2:

Wind direction: _____ Wind strength: _____ Wind stability: _____ GPS Loc: _____
Visible dust: _____ Description of dust: _____
Comment: _____

Site 3:

Wind direction: _____ Wind strength: _____ Wind stability: _____ GPS Loc: _____
Visible dust: _____ Description of dust: _____
Comment: _____

Diagram of Suspected source, dust assessment sites and dust plume:



COMMENTS

PART D: Source On-site Investigation

If source of dust identified, visit site, identify yourself and show warrant. Explain the findings of your investigation to staff.

Date: _____ Time: _____ Source Identified: _____

Staff spoken to: _____ Position: _____

Staff contact phone number: _____

Current site operations: _____

Reason/explanation given for dust _____

Other Comments _____

Monitoring results/samples/other records _____

Site Sketch (If Required)

SIGNED BY ASSESSOR _____

DATE: _____

PART E: Dust Reference Sheet

Definitions

Objectionable The term objectionable is the term used in consent conditions and is an ingredient of any subsequent enforcement action. It is a subjective term and is open to interpretation. There is guidance from case law which defines objectionable as: unpleasant or offensive or repugnant; open to objection or undesirable or disapproved of; noxious or dangerous. A test will be applied by the court that the term objectionable will be as it applies to "the minds of a significant cross section of reasonable people in the community". The assessor must bear this test in mind when completing their assessment.

Frequency How often an individual is exposed to dust nuisance events

Intensity As indicated by dust quantity/concentration and the degree of nuisance

Duration The length of the particular dust event

Character How objectionable the dust is, having regard to the nature of the dust

Land Beaufort Wind Scale

B. No.	Description	How to Recognise
0	Calm	Smoke rises straight up
1	Light Air	Smoke drifts
2	Light Breeze	Wind felt on face; leaves rustle
3	Gentle Breeze	Flags flap; twigs move all the time
4	Moderate Breeze	Papers blow; small branches move
5	Fresh Breeze	Small trees sway
6	Strong Breeze	Large branches move, wind whistles
7	Near Gale	Whole trees sway

Measuring Temperature

Use descriptions below or obtain local meteorological data, especially temperature from websites such as www.metservice.govt.nz

Cold
Cool
Mild
Warm
Hot

Measuring Cloud Cover

Okta No.	Description
0	Clear Sky
1	Sunny
2	Mostly sunny
3	
4	Half the sky is covered in cloud
5	
6	Mostly cloudy
7	Considerable cloudiness
8	Overcast
F	Fog / Mist

During the day the sun is always shining, so the amount of sunshine reaching the ground depends on the amount and duration of any cloud cover. The amount of cloud cover is usually given in units called oktas. Each okta represents one eighth of the sky covered by cloud.

Appendix 4: Dust management plans

This appendix outlines the issues that should be included in a management plan designed to address dust. In cases where companies already have documented procedures, some sections (for instance, staff training) may simply be cross-referenced.

Title and purpose of the plan

- Define the environmental effect to be managed under the plan, and the objective in relation to that effect.
- Identify the company and the site location, and briefly describe the company's activities.

Key personnel and contact addresses/numbers

- Company general manager and/or respondent to questions from the general public.
- Site manager.
- Environmental manager.
- Staff responsible for implementing the management system.

Complaints

- Complaint contact persons for community
- Complaint procedure for staff
- External reporting

Process description and method of operation

- A general description of the activities – describe the main potential sources of dust emission.

Methods of mitigation and operating procedures

- Fully describe the dust mitigation system.
- Identify relevant operating procedures and parameters that need to be controlled to minimise emissions.
- Inventory of mitigation equipment and materials.
- Details and reporting on equipment maintenance programmes, including measures to minimise failure.
- Contingency procedures.

Monitoring

Identify:

- types, places and frequencies of monitoring, including weather
- records to be kept, including documentation of maintenance and control parameters.

Staff training

- Areas staff are to be trained in.
- Methods used.
- Frequency of training.
- How and where training records are to be kept.

System review and reporting procedures

- The process for reviewing the overall system performance.
- Types and frequency of reports to council, including complaints records, site upgrades, etc.
- External audits and ISO certification (optional).

Glossary

Term	Definition
AAQG	Ambient air quality guidelines.
Acute	Short term exposure (eg, 1 hour).
Airshed	An area designated by a unitary authority, regional/district council for the purposes of managing air quality, and gazetted by the Minister.
Chronic	Long-term exposure (eg, over the period of a year).
Compliance	A range of activities usually carried out by agencies with regulatory functions to ensure people and other organisations adhere to rules and regulations for the public good.
Concentration	A amount of a pollutant (or dust) per unit of volume.
Deposited dust	Dust that is no longer in the air and which has settled on to a surface.
Dispersion modelling	Calculations of concentrations of an airborne pollutant downwind of a source.
DRI	Dust Risk Index.
Effects	The consequences airborne concentrations and/or dust deposition for a receptor. This may be nuisance due to soiling or decreased visibility, or more serious, such as increased morbidity or mortality due to exposure to PM ₁₀ or PM _{2.5} , or plant dieback due to reduced photosynthesis. The term 'effect' has a legal definition under the Resource Management Act 1991 (RMA) (see section 3.3.2).
Emission	Discharge to air.
FIDOL factors	Frequency, Intensity, Duration, Offensiveness/Character and Location. These factors determine whether dust has an objectionable or offensive effect.
IARC	International Agency for Research on Cancer.
m ³	Cubic metres.
National environmental standards	Mandatory nationwide standards.
PM	Particulate matter
PM _{2.5}	Particulate matter less than 2.5µm in diameter, sometimes referred to as 'fine' particulate matter.
PM ₁₀	Particulate matter less than 10µm in diameter, includes 'fine' particulate (less than 2.5µm) and 'coarse' particulate (2.5 to 10µm).
Receptor	A location that may be affected by dust emissions. Human receptors include locations where people spend time and where property may be impacted by dust. Ecological receptors are habitats that might be sensitive to dust.

Term	Definition
NES for air quality	Resource Management (National Environmental Standards for Air Quality) Regulations 2004.
Reverse sensitivity	Newer, more sensitive, activities constraining the ability of established activities to continue.
RMA	Resource Management Act 1991.
Risk	The likelihood and consequence of an adverse effect or event occurring.
Separation distance	Distance between a dusty activity and a sensitive activity.
Trackout	The transport of dust and dirt from a site on to the public road network, where it may be deposited and then re-suspended by vehicles using the network. This arises when heavy-duty vehicles leave the site with dusty materials, which may then spill onto the road, and/or when they transfer dust and dirt onto the road having travelled over muddy ground on-site.
Trigger level	Levels at which pro-active management of dust should occur
TSP	Total suspended particulates.
µg	Microgram, one millionth of a gram.
µm	Micrometre, one millionth of a metre.
WHO	World Health Organisation

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