Odour Management Framework: A Guide to Odour Management in Metro Vancouver

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INTRODUCTION
Metro Vancouver Regional District (Metro Vancouver) is responsible for managing air quality and regulating the discharge of air contaminants, including odorous air contaminants, in the region under authority delegated from the provincial government under the British Columbia (BC) Environmental Management Act. This document outlines an approach to managing odorous air contaminants that is consistent with and draws upon successful elements in Metro Vancouver’s existing approach to managing conventional air contaminants.

The purpose of the Odour Management Framework is to describe regional processes for maintaining and improving ambient air quality from the perspective of odour management, taking into consideration the unique conditions and requirements of the Metro Vancouver region. Information about different sources of odorous air contaminants, the potential impacts of odour on surrounding communities and the suite of tools Metro Vancouver uses to regulate and manage odorous air contaminants are included in this document. A range of approaches are used and no one approach will apply to all activities or industries.

MANAGING AIR QUALITY IN THE REGION
Metro Vancouver develops and implements air quality plans, policies and regulations to protect public health and the environment. Key features of air quality management in Metro Vancouver are:

- Pollution prevention;
- Continuous improvement;
- Developing innovative solutions to address emerging issues;
- Coordinating with other agencies to ensure effective approaches are implemented; and
- Outreach and education about issues.

Actions are developed based on: emerging public health information; data from the comprehensive ambient air quality monitoring network; an inventory of emissions in the airshed which quantifies emission sources and trends; and ongoing review of practices implemented in other jurisdictions and an assessment of their effectiveness.

REGULATORY APPROACH
Metro Vancouver has enacted bylaws and regulations which control air emissions and are designed to protect the environment and human health. Facilities and businesses may be authorized to discharge air contaminants through either site-specific permits or regulations that apply to groups of emission sources.

Metro Vancouver authorizes air emissions from various facilities through a permitting system. Permits may be issued to the largest sources of air contaminants, those with the potential for significant impacts, operations that are unique, or other facilities where authorizations are best handled in a site-specific manner. Currently, there are over 150 facilities in Metro Vancouver that operate under the requirements of an air quality permit.

In addition, the Metro Vancouver Board can adopt regulations to manage and control air emissions. Regulations can specify allowable emission levels, as well as monitoring and reporting requirements, and are generally applicable to groups of similar emission sources. This approach allows efficient and
equitable regulation of a large number of sources of small to medium-sized facilities. Currently, thousands of lighter industrial facilities and businesses are dealt with through emission regulations; these sources facilities and businesses are authorized through an emission regulation if they comply with the requirements of the regulation, including registering with Metro Vancouver.

Metro Vancouver’s approach to regulating emissions of conventional air contaminants through permits is predicated on stipulating conditions related to air discharges including setting emission limits (e.g., contaminant concentration, mass emission, discharge flow rate) and establishing monitoring and reporting requirements to demonstrate compliance with these limits. Test results are available to the public through www.metrovancouver.org (search ‘permit test reports’). Results can be searched by company or municipality.

Metro Vancouver has established ambient air quality objectives\(^1\) for a number of conventional air contaminants, such as nitrogen dioxide and fine particulate matter, which are routinely measured in the region. Ambient air quality objectives establish acceptable levels of air quality in the community, and may be considered in setting emission limits in permits.

A similar approach, using some combination of emission limits at the source and ambient criteria at the receptor, can be applied to managing emissions of odorous air contaminants since these contaminants behave like any other air contaminant and can be regulated in the same way.

**ODOUR IN METRO VANCOUVER**

**Effects of Odour**

Emissions of odorous air contaminants can interfere with many aspects of daily life and may have adverse effects on the lives and well-being of people exposed to odorous air contaminants, particularly if the resulting smell is unpleasant, strong and detected often.

Emissions of odorous air contaminants can be complex mixtures of many different chemicals that the human nose can detect at very low concentrations. Even at low levels, at which an odour causes a nuisance, a number of physiological responses have been reported in scientific papers, including nausea, eye irritation, headaches, sleep problems and respiratory symptoms\(^2\). If an offensive odour is persistent, it can affect a person’s mood, anxiety and stress levels. In addition, residents are sometimes unable to enjoy their own property and outdoor activities, such as gardening, barbecues and use of outdoor playgrounds. Residents also report having to close their windows and doors during hot weather or being embarrassed when unpleasant odours occur when they are entertaining guests.

**Sources of Odorous Air Contaminants**

Common sources of odorous air contaminants include solid and liquid waste management facilities, rendering plants, food and animal feed processing facilities, restaurants, petroleum refineries, manufacturing facilities, and agricultural activities. Odorous air contaminants can travel long distances, and the frequency and duration of the odour detected is influenced by weather conditions in the same way that weather influences the dispersion of conventional air contaminants.

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\(^1\) [http://www.metrovancouver.org/services/air-quality/AirQualityPublications/CurrentAmbientAirQualityObjectives.pdf](http://www.metrovancouver.org/services/air-quality/AirQualityPublications/CurrentAmbientAirQualityObjectives.pdf)

GUIDING PRINCIPLES
To be effective, odour management must protect air quality while achieving a balance between community and business interests. The Odour Management Framework is built on the following guiding principles, which were developed through discussions between staff from Metro Vancouver and the BC Ministry of Environment and Climate Change Strategy.

- **Promote livability and sustainability**
  - Consider regional economic prosperity, social well-being, and environmental stewardship.
  - Ensure policy and regulations support essential services, such as waste management and disposal, and the diversion of organic waste and other recyclable materials.

- **Emphasize prevention and control**
  - Minimize or mitigate impacts through best management practices and continuous improvement.

- **Encourage accountability**
  - Involve communities, business and government representatives in exchanging information about odour management practices.
  - Provide clarity for industry about requirements for managing emissions of odorous air contaminants.
  - Encourage regular sharing of information with the public who live and work in the Metro Vancouver region.

- **Recover the costs of managing odour issues**
  - Principles have been developed which guide the development of a system of fees in connection with Metro Vancouver’s service of air quality management and air pollution control.
  - A discharger pay approach is applied such that the costs associated with minimizing the impacts of emissions of odorous air contaminants should be covered by the parties responsible for the emissions.
  - Fees should be based on the quantity of contaminants discharged to provide an incentive to reduce discharges.

The following sections outline regulatory and non-regulatory approaches that can be combined to reduce emissions of odorous air contaminants in Metro Vancouver. Non-regulatory approaches, sometimes referred to as voluntary initiatives, are most effective if implemented proactively, and with participation by key stakeholders.

REGULATORY APPROACHES FOR ODOROUS AIR CONTAMINANTS

**Regulations**
As described above, emission regulations allow efficient and equitable regulation of a large number of sources of small to medium-sized facilities.

Emission regulations are currently in place for a number of sectors, such as gasoline distribution, automotive refinishing, boilers and heaters, and concrete batch plants. Metro Vancouver can develop new air quality emission regulations for industrial, commercial and institutional sources of emissions of odorous air contaminants.
Permits
Also described above, Metro Vancouver authorizes air emissions from various facilities through a permitting system.

Facilities with high odour potential may be issued a permit with stringent operating standards to manage emissions of odorous air contaminants, and requirements for a progressive odour management plan. Facilities with more complex emissions sources may be required to monitor odorous air emissions periodically or conduct dispersion modelling.

Assessment and Measurement
Odour assessments are conducted to follow up on odour complaints, verify compliance with conditions outlined in a permit and to determine the potential impact from new and existing operations. Commonly applied methods for assessing odorous air contaminants include: field observations, chemical analysis, dynamic olfactometry, and dispersion modelling.

Substances with odorous properties each have unique odour detection threshold values\(^3\). The detection threshold value is the concentration (expressed as µg/m\(^3\) or parts per billion) of an odorous air contaminant when it is first detectable by the human nose. For example, hydrogen sulphide has a relatively low odour detection threshold value (0.4 ppb) compared to formaldehyde (500 ppb), and hence can be detected at lower concentrations. The odour threshold value for a mixture of various odorous air contaminants cannot be predicted accurately based on individual odour threshold values, since odorous air contaminants can react with each other, and in combination may be additive, unrecognizable, or mask other odorous air contaminants. In addition, odour detection thresholds are not available for all odorous air contaminants.

Odorous air contaminants can be detected by the human nose at very low concentrations, and sometimes at concentrations lower than the detection limit of analytical instruments. Odours are occasionally the result of emissions of a single odorous air contaminant, but more commonly are due to a unique combination of hundreds of different odorous substances. Sources that emit only a limited number of odorous air contaminants (e.g., styrene from a fiberglass manufacturing facility), can use chemical analysis as an effective assessment tool. However for some emission sources (e.g., organics processing facilities) it can be difficult to identify all of the individual odorous air contaminants in the complex mixture. As the complexity of a mixture increases and concentrations of individual odorous air contaminants within the mixture decrease, it becomes more difficult to fully characterize the mixture based on the concentration of specific odorous air contaminants.

A number of tools are available to determine the presence of odorous air contaminants. Metro Vancouver can require the use of any of the techniques described below.

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\(^4\) Devos et al. 2010. Standardized Human Olfactory Thresholds
Chemical Analysis: Gas chromatography coupled with mass spectrometry (GC-MS) is an example of a laboratory method commonly used to analyse organic chemicals, including those found in air emissions. This approach is appropriate for quantifying individual odorous air contaminants and uses standard protocols that are widely accepted. For mixtures with a high number of individual odorous air contaminants, GC-MS analysis can be expensive. In addition, the results do not give information about human perception.

Dynamic Olfactometry: Olfactometry is a sensory measurement that uses the human nose to measure the concentration of a mixture of compounds. Metro Vancouver uses the standard method EN 13725\(^5\), which involves at least four trained panel members. An odour unit is the number of times that an odour sample must be diluted with odour-free air so that 50% of the panel can just detect the presence of the odour. For example, a sample of odorous air would be presented to a panel member at progressively decreasing dilution (increasing concentration); an odour concentration of 10 ou indicates that the sample was diluted 10 times before only 50% of the panel could detect the odour. An odour concentration of 1 ou indicates that the sample was at the threshold of detection\(^6\). This approach evaluates the mixture causing the odour, which is difficult to predict based on individual odorous air contaminants. One drawback with this method is that there are no commercial labs in BC currently offering this service; the nearest labs are in Ontario or the United States.

Field Observations: Metro Vancouver officers are sometimes able to respond immediately to complaints by conducting on-site observations. In this case, a sensory field test following an established protocol is the most appropriate approach. Field observations typically begin at the complainant’s location and odours are traced back to the source. If a specific facility is named, observations will usually be made upwind and downwind of the facility and other potential sources, and at the fence line of the suspect facility. Field observations provide immediate feedback to assess the relative level of odour present beyond the fence line, but the information is obtained in a relatively informal way. An additional limitation arises when complaints are made after the fact. It is also more difficult to evaluate the level of offensiveness using the collected information.

Dispersion Modelling: Dispersion modelling can be used to estimate concentrations of air contaminants or odour based on input data including emission rates (expressed in mass concentration or odour units), source characteristics, land use, topography and meteorological data. Ambient air contaminant concentrations at sensitive receptors can be predicted. Metro Vancouver requires air dispersion modelling for new and amended permits for facilities with a high potential to generate odorous air emissions. Dispersion models predict ambient odour concentrations for locations, typically maximum one-hour average concentrations. Although dispersion modelling provides useful information about the operation of a facility at the design stage and it can help assess the dispersion of emissions during operation, results of dispersion modelling may not fully represent the short-lived odour episodes associated with complex odours or account for unexpected localized events.

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\(^5\) European Committee for Standardization (CEN) formed a technical committee which developed a testing standard entitled EN 13725: “Air Quality-Determination of Odour Concentration by Dynamic Olfactometry”.

The selection of the most appropriate tool(s) depends on the purpose of the assessment. In many jurisdictions, odour impacts are measured using odour concentration or through the measurement of specific odorous air contaminants\(^7\). Some jurisdictions, such as the Bay Area Air Quality Management District in California, Japan and South Korea, assess odour by using both approaches, odour concentration and specific substances.

**Complaint Response**

An effective mechanism through which emerging problems are identified is complaint analysis. Metro Vancouver has a complaint response system in place to help resolve issues. The public can record outdoor air quality and odour complaints with Metro Vancouver using the complaint line or an online web form. In dealing with odour complaints, officers follow a complaint response procedure, including a set of questions to describe the odour using the ‘FIDOL’ characteristics (frequency, intensity, duration, offensiveness (unpleasantness), and location) and the weather conditions. Generally, officers are not able to independently verify each odour complaint. Metro Vancouver may proceed with an on-site investigation depending on the number of complaints received, wind direction, staff availability, and whether the complaint is received while the issue is still occurring.

Metro Vancouver receives complaints that can help identify emerging issues or areas where additional tools are needed to address a problem. Metro Vancouver also shares anonymized complaint data with facilities linked to odour complaints, and works to determine how facilities can implement appropriate corrective measures.

**NON-REGULATORY APPROACHES**

**Guidance Documents**

Guidelines and Best Management Practices use evidence-based approaches to help reduce air emissions and achieve compliance with regulatory requirements. Guideline documents can address facility design, construction, operation, maintenance and cleaning, as well as emissions monitoring and assessment. For example, Metro Vancouver uses the BC Air Quality Dispersion Modelling Guideline (2015) to ensure that dispersion modelling is done appropriately and is consistent with accepted practices. Where appropriate, Metro Vancouver could develop guideline documents for a specific activity, or adopt guidelines from other jurisdictions.

**Community Relations and Outreach Activities**

Community relations and outreach can include a wide variety of activities, such as ongoing communication and information exchange, which should be used proactively. Metro Vancouver has a public notification process through which information for new permit and major permit amendment applications is available to the public. Early communication by facilities discharging odorous air contaminants with nearby residents, as well as making results of ongoing monitoring data, inspections and test results available may be helpful in developing a shared understanding with residents.

Metro Vancouver works with local and provincial governments to ensure the approach to odour management is consistent with the principles applied in other jurisdictions.

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THE FUTURE FOR MANAGING ODOUR
Considerations in managing odour include a number of factors such as the nature and complexity of the odorous air contaminants being emitted from a source, additional potential sources of odorous air contaminants in the vicinity, the feasibility of applying technology to reduce emissions, and the regulatory mechanism being used to control emissions. Several tools and approaches have been identified in this framework document, which can be applied individually or in combination to reduce the impacts of odour. It is anticipated that as new actions, solutions, tools and techniques are developed and become available to Metro Vancouver, their potential effectiveness will be assessed and they will be integrated into this framework.
GLOSSARY
This glossary provides explanations of terminology used in the Odour Management Framework and is not intended to reflect legal definitions.

Ambient Air: Outdoor air that is not confined and is public.

Dispersion Modelling: A modelled simulation of how air pollutants disperse in the ambient atmosphere, based on mathematical descriptions of atmospheric conditions, terrain, emissions, and other input data.

Gas chromatography mass spectrometry (GC-MS): An analytical method by which complex mixtures of chemicals may be separated, identified and quantified.

FIDOL: A basic methodology for assessing the effects of exposure to emissions of odorous air contaminants through describing the following characteristics: Frequency, Intensity, Duration, Offensive and Location.

Odour: The property, characteristics or the quality of a substance that stimulates the olfactory organ and the sense of smell.

Odour detection threshold: The concentration at which half of an odour panel can identify the presence of an odour or odorous air contaminant without characterizing the stimulus. This is usually assessed as an average for populations, because individual people have different sensitivities.

Odour recognition threshold: The concentration at which half of an odour panel can recognize the odour, such as the smell of ammonia or peppermint.

Odour unit: A unit that refers to the number of times a sample of an odorous air contaminant or mixture of odorous air contaminants must be diluted with fresh (uncontaminated) air, in order to reach the point where it is just detectable.

Olfactometry: The measurement of odour by using the human sense of smell.

Odour Panel: A team of panel members who participate in a series of scientifically controlled sensory tests.

Panel member: Assessor qualified to participate in scientifically controlled sensory tests.

Sensitive receptor: Any location at which routine or normal activities occurring at reasonably expected times could result in people experiencing adverse effects due to the discharge of air contaminants, including odorous air contaminants. Sensitive receptors with respect to odorous air contaminants could include but are not limited to schools, hospitals, residences and public parks.

Source emissions: Emission source to the atmosphere. Emissions from a point source (e.g. at the point of discharge such as a stack or vent) or a non-point source (e.g., agriculture, forestry, construction, city streets).