

International Regulatory Approaches for Odour

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Abstract— Odour is a contaminant receiving increased attention and regulatory implications as residential sprawl encroaches on industrial, commercial and agricultural land. Regulatory approaches are varied within countries and around the world, and are often more subjective compared to regulations surrounding toxic and other risk based criteria. Odour criteria and regulations vary greatly. Depending on the jurisdiction, odour regulation approaches can be based on the contaminant emitted, the distance from sensitive receptors, the modelled odour concentration, or the perceived nuisance impact. This presentation provides an overview of the implementation and enforcement of various odour regulations.

Keywords—odour; odor; regulations; regulatory approach

I. INTRODUCTION

Odour is a contaminant receiving increased attention and regulatory implications as residential sprawl encroaches on industrial, commercial and agricultural land. Regulatory approaches are varied within countries and around the world, and are often more subjective compared to regulations surrounding toxic and other risk based criteria.

Odour criteria and regulations vary greatly. Depending on the jurisdiction, odour regulation approaches can be based on the perceived nuisance impact, the contaminant emitted, the distance from receptors, the ambient odour concentration, the ambient odour intensity, or a combination of FIDOL factors (frequency, intensity, duration, offensiveness, location). This paper provides an overview of select international odour regulations.

II. TYPES OF REGULATIONS

General prohibition is a popular choice for odour based regulations however there are a number of different approaches that have also been implemented by regulators. This paper provides an overview of the following types of international odour regulations:

- General Prohibition (Nuisance or Adverse Impact)
- Ambient Concentration of Chemical Constituents
- Setback Distances/Buffer Zones
- Ambient Odour Concentration
- Ambient Odour Intensity

- FIDOL Factors (frequency, intensity, duration, offensiveness, location)

III. GENERAL PROHIBITION (NUISANCE OR ADVERSE IMPACT)

Many jurisdictions regulate odour with a general prohibition regulation. The general prohibition regulation is generally enforced when there is the loss of enjoyment of property or a variation on that theme due to odour issues. Below are examples of the general prohibition regulations:

- The Florida Department of Environmental Protection (62-296.320 (2)): *"No person shall cause, suffer, allow or permit the discharge of air pollutants which cause or contribute to an objectionable odor."* [1]
- The State of Alabama (ADEM Admin. Code r. 335-3-4-.02 (3)) states that odours are prohibited by the following statement: *"When dust, fumes, gases, mist, odorous matter, vapors, or any combination thereof escape from a building or equipment in such a manner and amount as to cause a nuisance ..."* [2]
- The State of Arkansas (Reg 18.801) where odours are considered by the following rule: *"No person shall cause or permit the emission of air contaminants, including odors or water vapor and including an air contaminant whose emission is not otherwise prohibited by this Code, if the emission of the air contaminant constitutes air pollution."* [3]
- The State of Maryland (26.11.06.09) where odours are prohibited by the following statement: *"A person may not cause or permit the discharge into the atmosphere of gases, vapors, or odors beyond the property line in such a manner that a nuisance or air pollution is created."* [4]
- In the province of Ontario, odours are regulated by the Environmental Protection Act. Contaminants are defined as the following: *"means any solid, liquid, gas, odour, heat, sound, vibration, radiation or combination of any of them resulting directly or indirectly from human activities that causes or may cause an adverse effect"*, and the interpretation for an "adverse effect" includes the following statements: *"loss of enjoyment of normal use of property"* and *"interference with the normal conduct of business"*. Therefore odour is prohibited by Section 6 of the Ontario Environmental Protection Act: *"No person shall discharge into the natural environment any*

contaminant, and no person responsible for a source of contaminant shall permit the discharge into the natural environment of any contaminant from the source of contaminant, in an amount, concentration or level in excess of that prescribed by the regulations.” [5]

- The province of Quebec’s Ministry of Sustainable Development, Environment and Fight against Climate Changes (MSDEFCC) defines odour as a contaminant in section 1 of the Environment Quality Act (EQA). Amongst other prohibitions, section 20 of the EQA specifies that it is prohibited to emit, contaminants over the concentration provided by the regulation, or for which the presence is likely to affect the welfare or comfort of human beings. While there is no norm or criterion in this section, it provides MSDEFCC an enforcement tool [6].
- The province of New Brunswick’s Clean Air Act, Chapter C-5.2 states that: “No person shall, directly or indirectly, cause or permit the release into the air of a contaminant or a class of contaminant with the result that the release causes damage to any property, substantially interfere with the normal conduct of business, or cause substantial loss of the normal enjoyment of the use of any property” and defines odour as a contaminant [7].
- The UK Department for Environment Food and Rural Affairs defines a nuisance as the following: “Any dust, steam, smell or other effluvia arising on industrial, trade or business premises and being prejudicial to health or a nuisance.” [8]
- The Ireland Environmental Protection Agency specifies: “The licensee shall ensure that all operations on-site shall be carried out in a manner such that air emissions and/or odours do not result in significant impairment of, or significant interference with amenities or the environment beyond the site boundary”, and/or “The licensee shall ensure that [...] odours do not give rise to nuisance at the facility or in the immediate area of the facility. Any method used by the licensee to control any such nuisance shall not cause environmental pollution.” [9]

A list of jurisdictions with general odour prohibitions are provided in Appendix A.

These general prohibition clauses are open to subjective interpretation. The tolerance of a community to odour emissions from the local sources may vary considerably and will be strongly influenced by the character and hedonic tone of the odorous substance.

General prohibition laws are common but have a high potential of being applied in an inconsistent manner and leave room for many different interruptions. In addition, prosecution of an odour generator can be difficult when the definition of adverse impact/nuisance is left vague in the regulation; causing problems for both the regulators and the defendants. The

success of enforcement of general prohibition will be highly dependent on the regulators ability to win court cases and development of good case law.

IV. AMBIENT CONCENTRATION OF CHEMICAL CONSTITUENTS

If a chemical has a known odour threshold from human sensory testing, then the chemical may be regulated and measured directly in ambient air and the modelled concentration compared to the odour threshold. For example, the State of Connecticut (22a-174-23/Table 23-1) has a defined list of 12 chemicals with odour based concentrations that must not be exceeded, over a 15-minute average [10]. The Province of Ontario (O.Reg 419/05) uses a 10-minute averaging period and has a defined list of 31 chemicals with odour based thresholds [11].

Many jurisdictions have odour based ambient concentration limits, however they vary significantly. This is likely because there is a large variation in available odour detection thresholds. For example, hydrogen sulfide has an odour detection threshold that varies between 0.001 ppm to 0.13 ppm (1.4 µg/m³ to 181 µg/m³) [12]. Examples of jurisdictions with odour based thresholds for hydrogen sulphide are provided in Table 1.

TABLE 1. HYDROGEN SULPHIDE ODOUR BASED THRESHOLDS

Jurisdiction	Ambient Odour Threshold		Averaging Period	Converted Threshold (10-min) ^a
	µg/m ³	ppm		µg/m ³
Ontario [11]	13	0.0093	10-min	13
Quebec [13]	6	0.0043	4-min	5.2
Alberta [14]	14	0.0100	1-hr	23.1
Manitoba [15]	15	0.0108	1-hr	24.8
Connecticut [10]	6.3	0.0045	15-min	7.0
California [16]	42	0.0300	1-hr	69
Japan [17]	28 - 279	0.02– 0.2	-	-
South Korea [17]	28 - 84	0.02– 0.06	-	-

^a Converted thresholds are based on a 1-hr to 10-minute averaging conversion factor of 1.65 as prescribed by O.Reg 419/05 and the Air Dispersion Modelling Guideline for Ontario.

This approach can identify a parameter that would have the potential to cause an off-site odour by itself; however it does not attempt to address the potential for a mixture of airborne compounds to have a synergistic effect. Assessing compliance with the odour criterion on a compound specific basis may negate possible additive, subtractive, or synergistic effects caused by the presence of a mixture of two or more compounds and can be a point of contention in some instances.

V. SETBACK DISTANCES/BUFFER ZONES

Setback distances/buffer zones provide minimum separation distances between the odour generator and the receptor. They are usually dependent on the type of odour generation and the density/use of neighbouring land. Most

setback guidelines are developed for agricultural industries, however setbacks are also applied to industries known to have odour issue (landfills, composting, waste management, rendering, etc.).

The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) has developed minimum distance separation (MDS) formulae to be used to reduce land-use conflicts specifically related to odour. OMAFRA has stated that municipalities are responsible for ensuring that the MDS setbacks are met during land-use planning and permitting stages. The formulae inputs include animal/material type and quantity, manure form and storage capacity, tillable hectares, and distance to receptor. The MDS setbacks are applicable to expanding farms, new farms, and new developments to be built near farmland [18].

OMAFRA has also set MDS for nutrient management activities of non-agricultural material through the Nutrient Management Act (O. Reg 267/03). The setbacks range from 50 m to 900 m and depend on the type of material, the land-use, and method of incorporation [19].

Quebec's MSDEFCC has developed odour categories for residual fertilizing material for which minimal setback distances between application and residences are formulated [20]:

- O1 - Slightly odorous (less than dairy cattle manure) - No minimal distances
- O2 - Stinky (similar to dairy cattle manure) - Minimal distance of 75 meters
- O3 - Very stinky (between dairy cattle manure and swine manure) - Minimal distances of 500 meters
- HC - Non-Categorized (higher than swine manure) - Not authorized

The American Society of Agricultural and Biological Engineers (ASABE) have set "desirable distances" for livestock facilities. These distances range from 400 m to 800 m from domestic residences and 1600 m from housing developments. EPA guidance also recommends 3600 m to 7200 m from "larger facilities" [21].

There are also various setback distance models available for use in the United States including Minnesota OFFSET (Odor From Feedlots Setback Estimation Tool) and Nebraska OFT (Odor Footprint Tool). The Minnesota OFFSET model is based on a database of extensive odour measurements and dispersion modelling [22]. The Nebraska OFT uses dispersion modelling software, AERMOD, in conjunction with weather databases. This model also considers the type and size of facility in addition to any odour control technologies being used [23]. Both of these models can be used to estimate potential odour events around livestock facilities which can be used to determine minimum separation distances that livestock facilities should adhere to.

The Verein Deutscher Ingenieure (VDI) (Association of German Engineers) published a guideline on how to determine setback distances entitled "VDI3894 Part 2 – Emissions from and impacts of livestock operations – Method to determine

separation distances – Odour". This technical standard provides a simplified model which can be used to determine odour hour frequencies from livestock operations. The technical standard takes into account the emission source, location, and dispersion conditions and can be used to determine appropriate setback distances for livestock facilities [24].

The Rijkswaterstaat Ministry of Infrastructure and the Environment regulates air and odour emissions in The Netherlands. Minimum separation distances are determined based on the activity. For example, composting activities must take place at least 100 m from a sensitive object in an urban area and at least 50 m from a sensitive object outside the village. These same minimum separation distances are required for livestock operations as well [25].

The Environmental Protection Authority in South Australia has developed a guideline on determining the separation distances between various industrial operations and sensitive land uses. The guideline provides recommended distances which can be adjusted by provided surface roughness factors and terrain weighting factors. Depending on the activity, these separation distances can vary from 20 m to 2000 m [26]. A very similar guideline with separation distances is also used in Western Australia [27].

Set-back distances used at the planning level provide a mechanism to reduce the potential for complaints and land-use conflicts. They cannot be applied to existing infrastructure however they can be triggered for proposed expansions, redevelopments and zoning changes.

Setback distances are typically guidelines and it is assumed that municipalities will implement them during the planning and site plan approval stages. When not built into a regulation, political pressures and urbanization often negate the application of setbacks that would protect against industrial incompatibility and agricultural incompatibility.

VI. AMBIENT ODOUR CONCENTRATION

Odour is also frequently regulated using ambient odour concentration criteria over a defined averaging time. The ambient concentration is typically determined using odour laboratory results and air dispersion modelling or through field olfactometry.

The ambient odour criterion used by the Manitoba Conservation is 2 OU for residential receptors and 7 OU in industrial areas [15]. These criteria must be used when assessing environmental impacts of new developments.

The province of Quebec regulates the composting industry through the Lignes directrices pour l'encadrement des activités de compostage [28]. The composting guideline states that odour emissions must not cause an odour exceedance of 1 OU (4-minute) 98% of the time and 5 OU (4-minute) 99.5% of the time. Typically, it is considered that odour emissions must not exceed 10 OU (4-minute) outside of an industrial zone. These odour criteria are usually applied to other industries where odour may be of concern such as wastewater treatment facilities, rendering facilities, and other odorous operations.

The ambient odour criterion used by the Ontario Ministry of the Environment and Climate Change (MOECC) is defined as 1 OU (10 minute) at a sensitive receptor 99.5% time of the year. The MOECC's criterion of 1 OU is not set out in a regulation, but is utilized routinely in the air permitting approvals and abatement processes when odour emissions are identified as a concern. The 1 OU criterion may be written as a special condition into an air permit, which gives it the force of law for the source. Compliance with the 1 OU odour criterion is demonstrated by completing odour source testing and dispersion modeling to calculate the maximum off-site odour impacts at sensitive receptors (generally residential). Sensitive receptors also include daycares, educational facilities, campgrounds, places of worship, and health-care facilities.

Ontario's criterion of 1 OU is relatively stringent compared to the similar criteria of 7 or 8 OU used in many of the United States. The discussion below shows that one of the most common quantitative odour criterion used in the United States is eight OU (odour should not be detected when diluted with 7 volumes of clean air).

The state of Wyoming (WDEQ Ch. 2, Section 11) ambient air standard for odours from any source is a Scentometer reading that is not greater than 7 dilutions with odour free air [29].

In the state of Colorado (5 CCR 1001-4), it is a violation if odours are detectable after being diluted with 7 volumes of odour-free air in a residential or commercial area. For all other areas, it is a violation if odours are detected after being diluted with 15 or more volumes of odour-free air. Two odour measurements must take place within a period of 1 hour and be separated by at least 15 minutes [30].

In the state of Illinois (Chapter I, Part 245) an odour is considered a nuisance on or near residential, recreational, institutional, retail sales, hotel or educational premises where the odour is detectable after being diluted with 8 volumes of odour-free air. In industrial areas, an odour is a nuisance if detectable after being diluted with 24 volumes of odour-free air. For all other areas not listed, an odour is a nuisance if the odour is detectable after being diluted with 16 volumes of odour-free air. These odour measurements must be taken by three trained inspectors in a 1 hour period separated by at least 15 minutes and result in two positive determinations in each series of three determinations [31].

The New South Wales, Environment Protection Authority has developed an odour assessment criteria dependent on population densities [32] as follows:

- 7.0 OU for a single residence (< 2),
- 6.0 OU for a population of 10,
- 5.0 OU for a population of 30,
- 4.0 OU for a population of 125,
- 3.0 OU for a population of 500, and
- 2.0 OU for an urban population (> 2000) and/or schools and hospitals.

The New Zealand Ministry for the Environment recommended odour guideline values have been determined based on the sensitivity of the receiving environment and meteorological conditions. The sensitivity of an area is determined from factors such as land use and the presence of any background odours. These values are as follows: 1 OU/m³ for a high sensitive area with unstable to semi-unstable conditions, 2 OU/m³ for a high sensitive area with neutral to stable conditions, 5 OU/m³ for a moderately sensitive area in all conditions, and 5-10 OU/m³ for a low sensitive area in all conditions. These values are all considered as 1 hour averages [33].

The Scottish Environment Protection Agency has developed criteria as an indicator for significant pollution based on the relative offensiveness of the odour [34]. Values for hypersensitive populations have been created to account for the small percentage of population who predictably will generate a higher level of complaint. The three categories of offensiveness are listed as follows:

- More offensive odours (livestock feed factory, oil refining, wastewater treatment, etc.) have a minimum criteria of 1.5 OU/m³ and 1.0 OU/m³ for hypersensitive populations.
- Odours which do not obviously fall within a high or low category such as intensive livestock rearing, food processing, sugar beet processing, etc. have a minimum criteria of 3 OU/m³ and 2.5 OU/m³ for hypersensitive populations.
- Low offensive odours (chocolate, manufacture, brewery, bakery, etc.) have a minimum criteria of 6 OU/m³ and 5.5 OU/m³ for hypersensitive populations. These values are all considered as 1 hour averages.

Ambient odour thresholds are best implemented when land use is taken into consideration. Higher thresholds for commercial/industrial areas and lower thresholds for sensitive receptors allow for the protection of receptors where sensitivities are typically higher and drive complaints while still protecting the comfort of workers in neighbouring industrial/commercial buildings. Setting odour thresholds at property lines reduces the potential to receive complaints but may require industries to install abatement equipment when it may not be needed.

Ambient odour thresholds provide a level playing field for industry but modelling compliance with the threshold does not guarantee odour complaints will not occur and can be difficult to implement for existing developments. Proof of compliance requires stack testing or infield measurements during appropriate operating and meteorological conditions.

VII. AMBIENT ODOUR INTENSITY

Odour intensity is a description of the perceived strength of the odour using terms such as “not perceptible”, “weak”, or “strong”. The intensity of an odour not only describes presence of an odour but the relative strength of it. Ambient odour intensity can be determined in two ways:

1. Ambient sampling or
2. Ambient field observations.

Ambient sampling would involve collecting of a sample of air and comparing it to the odour intensity of varying known concentrations of an odorant such as n-butanol. The n-butanol method is referenced to the American Society for Testing and Materials (ASTM) method E 544-10 "Standard Practices for Referencing Suprathreshold Odour Intensity". Field observations involve trained personnel conducting a field audit and comparing the observations to a set scale of intensity.

Another method of measuring intensity is from the German Standard VDI3882, Part 1 Olfactometry - Determination of Odour Intensity [35]. This standard provides a numerical scale to describe the perceived intensity of the odour and is shown in Table 2.

TABLE 2. VDI3882 – ODOUR INTENSITY RATING SCALE

Odour Strength	Intensity Level
Extremely Strong	6
Very Strong	5
Strong	4
Distinct	3
Weak	2
Very Weak	1
Not Perceptible	0

This intensity rating system is applied in a laboratory by use of an odour panel and dynamic olfactory equipment. Through this method, laboratory operators are able to compare the perceived intensity with the calculated concentration for the specific odour sample. This information can be used to evaluate odour complaints. This German standard is used by other jurisdictions such as the Department for Environment, Food and Rural Affairs in England [8] and Department of Environmental Protection in Western Australia [36].

Ambient field observations are used by environmental personnel when investigating an odour complaint. The complaints should be investigated as expeditiously as possible to ensure an accurate evaluation. The State of New Jersey Department of Environmental Protection has developed an air pollution investigation guideline for personnel to follow to quickly review complaints of air pollution (including odour). This guideline uses an intensity scale from 1 (no odour) to 5 (very strong) to describe odours. This scale is used in conjunction with other FIDOL factors for investigators to use to validate an odour complaint and determine if a violation exists [37].

Ambient odour intensity can be important for odours that are very strong, even at low concentrations. A low odour concentration may not fairly represent the intensity receptors feel. Alternatively, an increase in odour concentration may not increase the odour intensity when the odour is pleasant or non-offensive to receptors. Depending on the specific case and the

timeline involved, ambient sampling or ambient field observations can be used to determine the odour intensity. Odour sampling will provide more data to work with than field observations since the intensity rating can be compared to calculated odour concentrations. However, if an immediate response or action is required, an ambient field observation can be performed where the intensity rating can be used to determine the validity of an odour complaint.

VIII. FIDOL FACTORS (FREQUENCY, INTENSITY, DURATION, OFFENSIVENESS, LOCATION)

Determination of a potential odour nuisance is often conducted by regulators using FIDOL factors. FIDOL factors are not typically found directly in an odour regulation but are often found in guidance documents for regulators to assess odours. These factors are described in Table 3.

The Scottish Environment Protection Agency has developed a guidance document to help understand, investigate, and provide mitigation for odour related activities [34]. The FIDOL factors are an important resource in determining whether or not an odour is an “offense to human senses.” These factors can be used in conjunction with other methods to develop an objective conclusion regarding any given odour.

The New Brunswick Department of the Environment has developed an internal nuisance odour guideline that provides a FIDOL rating system for regulators to use while investigating odour complaints. The guideline also includes an odour rating matrix based on the FIDOL parameters modelled on the Scottish Environment Protection Agency Odour Guidance [38].

The Department for Environment, Food and Rural Affairs guideline also utilizes FIDOL factors to classify odours. When a complaint of nuisance is issued, environmental health practitioners (EHPs) must perform a complete investigation to provide an objective and reasonable solution for both the site operators and the odour sensitive receptors. The FIDOL factors are useful to allow EHPs to develop a complete assessment [8].

The relative impact of an odour on a sensitive receptor can greatly vary so it is important to attain as much information as possible to properly categorize the odour. As some regulatory

TABLE 3. DESCRIPTION OF FIDOL FACTORS

Factor	Description
Frequency	How often the receptor experiences an odour episode
Intensity	The overall strength of the odour
Duration	The length of time of each odour episode
Offensiveness	The offensiveness of an odour based on the hedonic tone (pleasant, neutral, or unpleasant).
Location	The location of the receptor (i.e. residential, commercial, institutional, industrial)

organizations have already learned, these FIDOL factors are particularly useful when performing investigations into complaints of odour nuisance. Incorporating FIDOL factors into odour investigations help regulators to come to an objective conclusion that is fair for odour generating facilities and sensitive receptors.

IX. CONCLUSIONS

As communities continue moving closer and closer to industrial and agricultural areas, regulators will need to consider that there will be the potential for odours to be detected and recognized. Detected and recognized odours do not always mean that there is an adverse impact. Public education and involvement will be key tools in overcoming the public perception that all odours are bad odours.

Communities and regulatory agencies will need to develop a system that balances the needs of the industries and agricultural areas with ever expanding and encroaching developments.

Addressing odour will need to be a combination of a number of the approaches described in this paper. FIDOL factors should always be considered when assessing odour nuisance. FIDOL provides a rating system that is a key tool for the investigation of odour complaints. Public education and involvement, although not described in this paper, is critical in understanding and resolving odour complaints.

There will never be a perfect solution to dealing with odour problems from a regulatory standpoint however relying only on general prohibitions leave regulators, industries, and sensitive receptors with little recourse.

General prohibition is the default approach for most jurisdictions when dealing with odour. The general prohibition approach leaves industrial and agricultural operations at risk when dealing with sensitive receptors as it is open to subjective interpretation.

The ambient odour approach has gained momentum and has some benefits over the general prohibition approach. The ambient odour approach requires odour generating operations to meet a certain odour criterion at receptors. The ambient odour approach has documented methodology for quantifying the odour and is less impacted by subjective interpretation.

A combination of the odour approaches and public awareness will assist in striking a fair balance between the public and odour generating operations.

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Appendix A - Summary of Ambient Air Odour Regulations

Jurisdiction	Document/Governing Body	Odour Regulation Citation	No Regulation	General Prohibition	Odour Regulation	Comments & Description of Odour Impact Criteria
Canada						
Alberta	Revised Statutes of Alberta 2000 Chapter E-12	E-12, Part 5, Division 1 (109,116)		x		
British Columbia	BC Air Quality Website	N/A		x		
Manitoba	Odour Nuisance Management Strategy	N/A		x		
	Ambient Air Quality Criteria Table	N/A			x	Maximum acceptable level concentration of 2.0 - 7.0 OU depending on land use.
New Brunswick	Clean Air Act, SNB 1997	Ch. C-5.2 (6.2)		x		
Newfoundland	Environmental Protection Act	Ch. E-14.2 (7.1)		x		
Nova Scotia	N/A	N/A	x			
Ontario	Environmental Protection Act	Ch. E.19 (6)		x		
	Summary of Standards and Guidelines to support Ontario Regulation 419/05	Ontario Regulation 419/05			x	Odour impact determined on a contaminant basis.
Prince Edward Island	Environmental Protection Act	Ch. E-9 (20)		x		
Quebec	Environment Quality Act (EQA)	Ch Q-2, Division IV, Section 20		x		
	Environment Quality Act (EQA)	Ch Q-2, Division VI, Section 16			x	Maximum limit of 100 - 120 degrees of odour per cubic meter depending on plant.
Saskatchewan	Saskatchewan Air Quality Modelling Guideline	N/A			x	Maximum Limit of 1 - 6 OU depending on land use.
United States						
Alabama	Alabama Department of Environmental Management	ADEM Admin. Code r. 335-3-4-.02		x		
Alaska	Department of Environmental Conservation	18 AAC 50.110		x		
Arizona	N/A	N/A	x			
Arkansas	Arkansas Air Pollution Control Code	Reg. 18.801		x		
California	N/A	N/A	x			
Colorado	Air Quality Control Commission	Regulation 2, 5 CCR 1001-4			x	Detection when diluted with 7 or more volumes of odour-free air. Measurement distance depends on the land use and receptor.
Connecticut	Department of Energy & Environmental Protection	Section 22a-174-23			x	Detection when diluted with 7 or more volumes of odour-free air. Odour limits for 12 chemicals in ppm (15 minute averages).
Delaware	Natural Resources & Environmental Control	Title 7, 1119		x		Scentometer tests, air quality monitoring, and affidavits can be used to determine nuisance from odour.
Florida	Florida Department of Environmental Protection	Chapter 62-296.320 (2)		x		
Georgia	N/A	N/A	x			
Hawaii	N/A	N/A	x			
Idaho	Department of Environmental Quality	58.01.01 - 775 & 776		x		
Illinois	Illinois Pollution Control Board	Ch. I. SubCh. I - 245.121			x	Detection when diluted with 8 or more volumes of odour-free air.
Indiana	N/A	N/A	x			
Iowa	N/A	N/A	x			
Kansas	Kansas Department of Health and Environment	28-19-13		x		
Kentucky	Kentucky Environmental Protection Agency	Title 401 KAR 53:010			x	Detection when diluted with 7 or more volumes of odour-free air.
Louisiana	Louisiana Department of Environmental Quality	Title 33, Part III, Ch. 29			x	Detection at 6 or greater on 9 point butanol intensity scale.
Maine	Maine Department of Environmental Protection	Ch 409 & 410			x	Detection based on a modified 5-point odour intensity referencing scale.
Maryland	Maryland Department of Environment	26.11.06.09		x		
Massachusetts	Massachusetts Department of Environmental Protection	310 CMR 7.09		x		
Michigan	Michigan Department of Environmental Quality	R 336.1901		x		
Minnesota	N/A	N/A	x			
Mississippi	Mississippi Department of Environmental Quality	Title 11, Part 2, Ch. 4		x		Considers the number and frequency of complaints and land use.
Missouri	Missouri Department of Natural Resources	10 CSR 10-6.165			x	Detection when diluted with 7 or more volumes of odour-free air.

Appendix A - Summary of Ambient Air Odour Regulations

Jurisdiction	Document/Governing Body	Odour Regulation Citation	No Regulation	General Prohibition	Odour Regulation	Comments & Description of Odour Impact Criteria
Montana	N/A	N/A	x			17.8.315 has been repealed.
Nebraska	N/A	N/A	x			
Nevada	Nevada Department of Conservation and Natural Resources	NAC 445B.22087			x	Detection when diluted with 8 or more volumes of odour-free air. Odour must be described as objectionable by at least 30% of sample population.
New Hampshire	N/A	N/A	x			
New Jersey	New Jersey State Department of Environmental Protection	7:27-5		x		
New Mexico	N/A	N/A	x			
New York	New York State Department of Environmental Conservation	6 CRR-NY 211.1		x		
North Carolina	North Carolina Division of Air Quality	15A NCAC 02D .1806		x		
North Dakota	North Dakota Department of Health	23-25-11			x	Detection when diluted with 7 or more volumes of odour-free air. Measurement distance depends on the land use and receptor.
Ohio	Ohio Division of Air Pollution Control	3745-15-07		x		
Oklahoma	N/A	N/A	x			
Oregon	Oregon Department of Environmental Quality	340-208-0300		x		
Pennsylvania	Pennsylvania Bureau of Air Quality	123.31		x		
Rhode Island	Rhode Island Department of Environmental Management	Regulation No. 17			x	Staff member evaluates if odour is objectionable based on nature, concentration, location, duration, and source.
South Carolina	South Carolina Environmental Protection and Conservation	Section 48-1-110, 120		x		
South Dakota	N/A	N/A	x			
Tennessee	N/A	N/A	x			
Texas	Texas Commission on Environmental Quality	TAC Rule §101.4		x		
Utah	Utah Division of Air Quality	R307-102-1		x		
Vermont	Vermont Air Quality & Climate Division	Subchapter 2, 5-241			x	No objectionable odour beyond property line.
Virginia	Virginia State Air Pollution Control Board	9VAC5-50-140			x	Objectionable odour determined by investigation which may include odour panel survey and/or other methods approved by board.
Washington	Washington Department of Ecology	WAC 173-400-040 (5)		x		
Washington D.C.	N/A	N/A	x			
West Virginia	West Virginia Division of Air Quality	Title 45, Series 4, Section 3			x	Objectionable odour as defined by authorized state investigator.
Wisconsin	Wisconsin Department of Natural Resources	NR 429.03			x	sample population.
Wyoming	Wyoming Air Quality Division	Chapter 2, Section 11 (a) (i)			x	Detection when diluted with 7 or more volumes of odour-free air.
Other Jurisdictions						
UK (England, Scotland, Wales)	UK Environmental Protection Act 1990	Part 3, Section 79		x		
Scotland	SEPA Odour guidance 2010	Part 2, Section 2.3			x	Maximum Limit of 1 - 6 OU depending on relative offensiveness of odour.
Ireland	Clean Neighbourhoods and Environment Act (Northern Ireland) 2011	Part 7, Section 63		x		
Germany	Guideline on Odour in Ambient Air – GOAA	Section 2			x	Not to exceed exposure limits based on land use.
Australia						
Western Australia	Environmental Protection Act 1986	Part V, Division 1, Section 49 (1)		x		
New South Wales	Protection of the Environment Operations Act 1997	Section 129		x		
	Assessment and management of odour from stationary sources in NSW	Section 3.3			x	Maximum Limit of 2 - 7 OU depending on land use.
South Australia	Environment Protection Act 1993	Section 82		x		
Queensland	Environmental Protection Act 1994	Ch 1, Section 14 & 15		x		
New Zealand	Resource Management Act 1991	Part 3, Section 15		x		
	Good Practice Guide for Assessing and Managing Odour in New Zealand	4.11.4			x	Maximum Limit of 1 - 10 OU depending on land use.