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Air Quality
Standards & Nuisance Issues for Animal Agriculture

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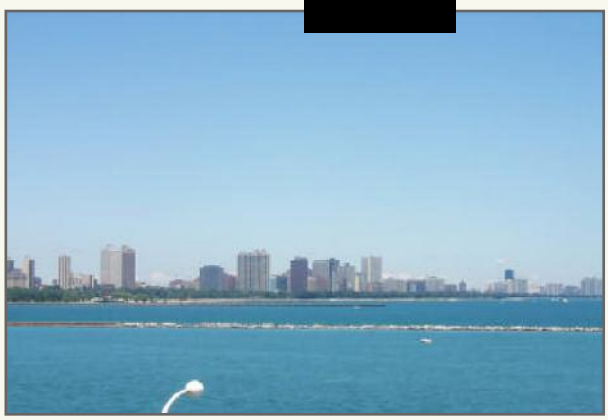
The concentration of large numbers of livestock and poultry confinement facilities, which began in the 1990s, has become common practice in the animal industry. Until recently, the operators of animal feeding operations, or AFOs, did not have much knowledge about the Clean Air Act (CAA) and its implications for animal agriculture. Now, however, air quality standards are being strictly enforced.

FIGURE 1



Chicago in the summer of 2000: a clear day (above) with $PM_{2.5}$<5μ g/m^3; and a poor visibility day (above right) with $PM_{2.5}$~35μ g/m^3.
(Source: USEPA, accessed Feb. 21, 2006, http://www.epa.gov/airnow/2003conference/presentations2003/Paisie.pdf)

National Ambient Air Quality Standards

Air pollution is categorized as a **health concern** for humans, animals or plants when, for example, an amount of pollutants in the air is considered to be harmful. It can also be a nuisance because of odors interfering with the enjoyment of life or normal use of property.

The first national legislation to deal with air pollution was the Air Pollution Control Act of 1955, which was followed by the Air Quality Act of 1967. Three years later came the CAA Amendment, an important piece of environmental legislation intended to curb air pollution—particularly smoke and smog—from large, industrial cities. This legislation required the U.S. Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS).

The NAAQS were developed for six "criteria pollutants" that the EPA considered to be common throughout the United States:

- Carbon monoxide (CO),
- Lead (Pb),
- Nitrogen dioxide (NO_2),
- Ozone (O_3),
- Particulate matter (PM) and
- Sulfur dioxide (SO_2).

These pollutants were called criteria pollutants because they were based on two criteria: **primary standards** to protect public health; and **secondary standards** to protect public welfare, such as

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decreased visibility (Figs. 1 and 2) and damage to animals, crops, vegetation and buildings. Table 1 lists the primary and secondary standards for these criteria pollutants.

Because different pollutants have different effects on public health and welfare, the NAAQS for these criteria pollutants are also different. Some pollutants have standards for *long-term* and *short-term* averaging times. The short-term standards protect against acute or short-term health effects, while the long-term standards guard against chronic health effects. The amounts of these pollutants are reported as concentration in parts per million (ppm) by volume, or as mass concentration in milligrams per cubic meter (mg/m^3) and micrograms per cubic meter ($\mu g/m^3$) of air.

FIGURE 2

Reduced visibility caused by PM emission from animal feeding operations.

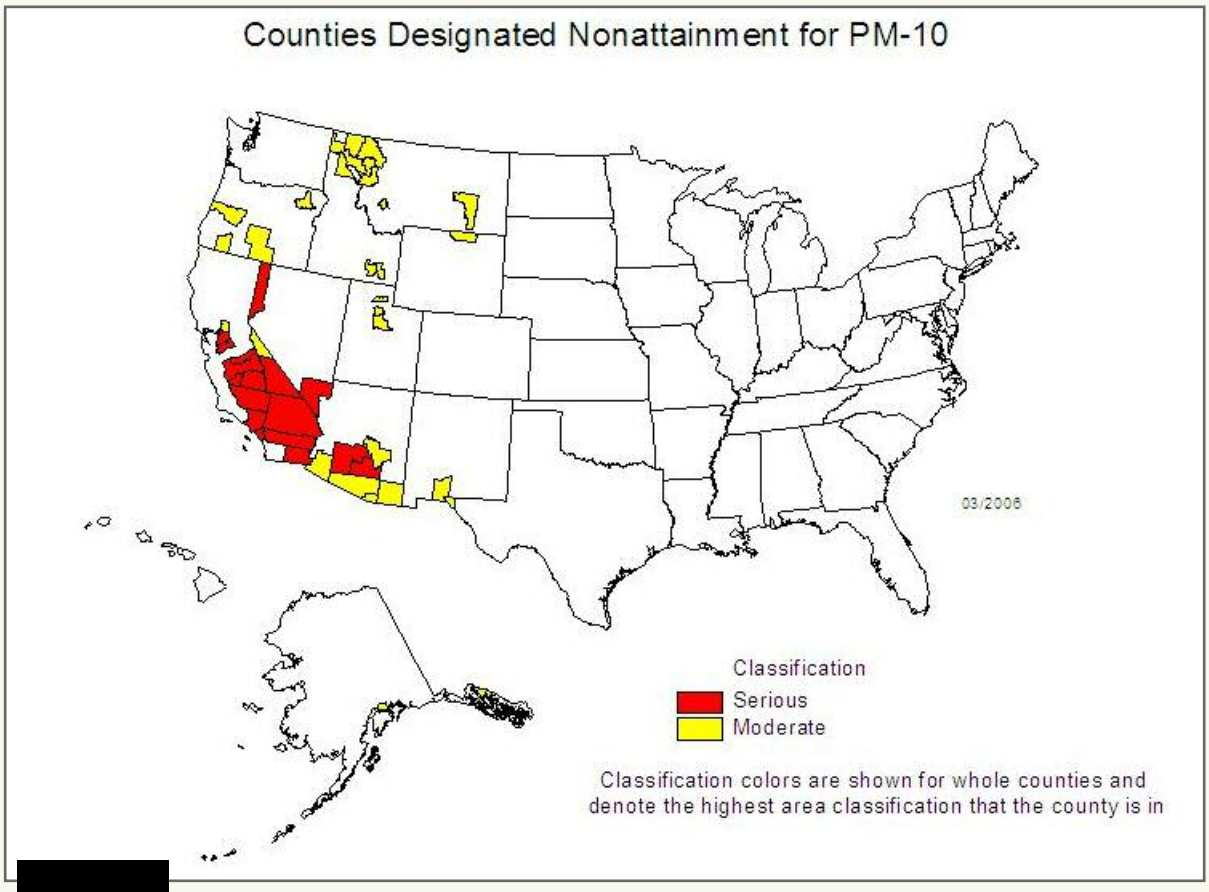

FIGURE 3

PM nonattainment area map. (Source: USEPA, accessed Feb. 17, 2006, http://www.epa.gov/air/oaqps/greenbk/pindex.html)

Table 1 (page 4) shows that all criteria pollutants except carbon monoxide have primary and secondary standards. In 1997, the EPA divided particulate matter into two categories (PM_{10} and $PM_{2.5}$) to designate different size particles. $PM_{2.5}$ is also known as PM fine (Table 1).

Throughout the United States, a network of approximately 4,000 State and Local Air Monitoring Stations (SLAMS) provide air quality data to determine if regions are meeting or exceeding the NAAQS. A geographic area is deemed a "non-attainment area" if the NAAQS for a certain criteria pollutant is exceeded. Regions staying at or below the NAAQS are known as "attainment areas."

Figures 3 and 4 illustrate both categories for two criteria pollutants: PM_{10} and ozone. Western states, especially California and Arizona, are classified mostly as serious non-attainment states for PM_{10} (Fig. 3).

Large urban areas of several states, including Houston, Dallas and San Antonio, are considered non-attainment areas (Fig. 4) for the 8-hour ozone standard.

The EPA, state and regional pollution control agencies have been monitoring air quality and reporting emissions for criteria pollutants since the 1970s. Data in Table 2 **(page 5)** indicate that the emissions of individual pollutants have decreased steadily over time and that the total emissions of these pollutants in 2004 were less than half of what they were in 1970.

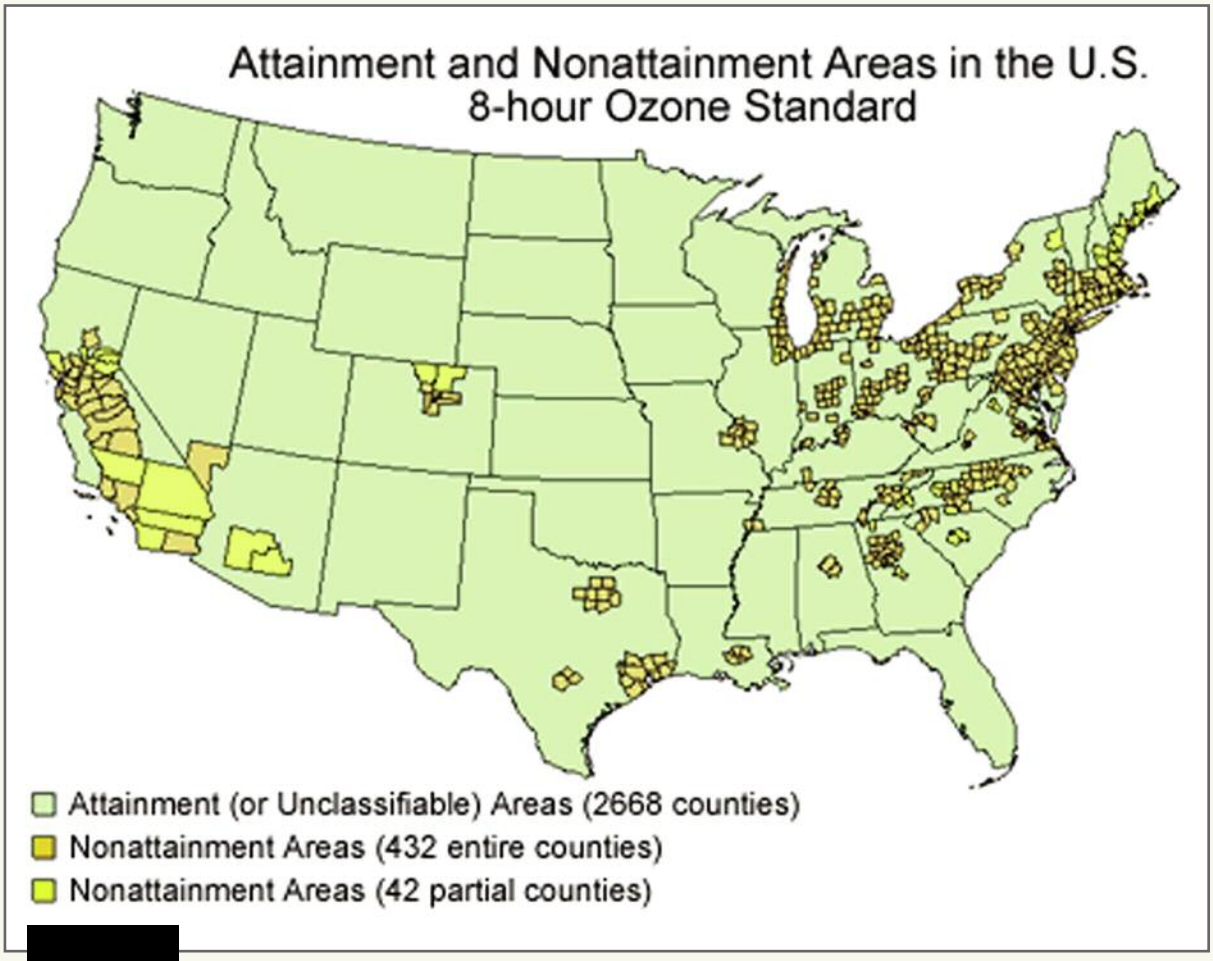

FIGURE 4 **Ozone nonattainment area map. (Source: USEPA, accessed Feb. 17, 2006, http://www.epa.gov/ozonedesignations/nonattaingreen.htm)**

In 1990 the CAA was amended, authorizing the EPA to fine violators. The act contains eleven separate titles for addressing air quality issues. One of them is Title V.

EPA and state air pollution regulatory agencies (SAPRA) grant Title V permits to operate major, stationary sources of pollution. An AFO, or any other operation, is considered a major, stationary source of emission if it has the potential to emit more than the annual emission threshold for a criteria pollutant. Major sources must pay an annual fee on every ton of regulated pollutant emitted, including fugitive emissions.

Fugitive emissions are to air what non-point source emissions are to water and cannot be measured at the end of a pipe or orifice. For example, if a source is subject to Title V permitting because of its PM_{10} emissions, then it must pay annual fees on all other criteria pollutants (e.g., So_x, NO_x and O_3) that it may emit.

Hazardous Air Pollutants (HAPs)

The EPA also considers substances such as volatile organic compounds (VOCs), pesticides and herbicides as toxic air pollutants. It maintains a list of these substances on its web site (http://www.epa.gov/air/toxicair/newtoxics.html, accessed Feb. 8, 2006). Toxic air pollutants, also known as hazardous air pollutants (HAPs), cause—or are suspected to cause—serious health effects (e.g., cancer and birth defects) or adverse environmental effects.

Two particular gases, ammonia (NH_3) and hydrogen sulfide (H_2S), are not listed as HAPs. However, H_2S is included in the CAA [section 112-9(r)] and is subject to accidental release provisions. Higher emissions of NH_3 may cause the formation of ammonium aerosol, which reacts with acids (e.g., nitric or sulfuric acid) in the atmosphere and contributes to the formation of $PM_{2.5}$ or soil and water acidification.

Ammonia emissions from AFOs and other sources may be regulated as HAPs soon.

Ammonia and Hydrogen Sulfide Reporting Requirements

Two federal acts already require reporting of ammonia and H_2S emitted from point sources at AFOs. Examples are exhaust from confinement structures, such as a mechanically ventilated barn, and manure storage/treatment structures, such as lagoons. Reporting requirements fall under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Emergency Planning and Community Right-To-Know Act (EPCRA).

This legislation is not part of the CAA, but both acts require that releasing these two and several other toxic air contaminants above a determined quantity be reported. For example, emissions of more than 100 pounds of NH_3 in a 24-hour period must be reported. Violators of CERCLA and EPCRA reporting requirements may be fined $27,000 and $10,000 per day, respectively.

Odors

Unlike criteria pollutants, HAPs and other toxic air contaminants, odors are not federally regulated under the CAA. Generally, SAPRAs and/or local, regional or municipal authorities regulate odors under the nuisance standard.

Texas and most other states indirectly regulate odors through setbacks, permitting, operator training and land-application restrictions. A few states require direct methods, using rules and standards that prohibit the release of odors above odor detection thresholds which are measured at the AFO or which are determined in the laboratory from odorous air samples.

National Ambient Air Quality Standards (NAAQS)

Pollutant	Primary Standards	Averaging Times	Secondary Standards
Carbon Monoxide (CO)	9 ppm (10 mg/m^3)	8 hours[1]	None
	35 ppm (40 mg/m^3)	1 hour[1]	None
Lead (Pb)	1.5 μg/m^3	Quarterly Average	Same as Primary
Nitrogen dioxide (NO_2)	0.053 ppm(100 μg/m^3)	Annual (Arithmetic Mean)	Same as Primary
Particulate Matter (PM_{10})	50 μg/m^3	Annual[2] (Arith. Mean)	Same as Primary
	150 ug/m^3	24 hours[1]	
Particulate Matter ($PM_{2.5}$)	15 μg/m^3	Annual[3] (Arith. Mean)	Same as Primary
	65 ug/m^3	24 hours[4]	
Ozone (O_3)	0.08 ppm	8 hours[5]	Same as Primary
Sulfur dioxide (SO_2)	0.03 ppm	Annual (Arith. Mean)	
	0.14 ppm	24 hours[1]	
		3 hours[1]	0.5 ppm (1300 ug/m^3)

TABLE 1 **Current National Ambient Air Quality Standards (NAAQS) for criteria pollutants. (Source: USEPA, accessed Feb. 8, 2006, http://www.epa.gov/air/criteria.html)**

NOTES:

[1] *Not to be exceeded more than once per year*

[2] *To attain this standard, the 3-year average of the weighted annual mean PM_{10} concentration at each monitor within an area must not exceed 50 ug/m^3.*

[3] *To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 ug/m^3.*

[4] *To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 65 ug/m^3.*

[5] *To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.*

Summary

Operators of concentrated animal feeding operations face increased scrutiny and accountability for the extent to which their facilities may impair air quality for their neighbors and communities. That accountability can involve nuisance complaints, lawsuits, increased permitting burdens, novel or stricter applications of existing law, new municipal ordi-

nances, or state and federal regulations. It is a complicated, multi-faceted challenge that will require AFO operators to stay abreast of developments and new precedents on all of those fronts.

In the meantime, operators should become familiar with fundamental air quality principles, which will help them devise innovative strategies or adapt existing techniques to reduce the air quality impact of their facilities. This will also enable them to anticipate how management techniques to reduce one air pollutant might create or intensify problems with another air pollutant. Producers should educate their neighbors and communities about these issues where possible so that they can reduce the likelihood of destructive, expensive confrontations over nuisances or regulatory violations.

National Air Pollutant Emissions Estimates

TABLE 2

	Millions of tons per year							
	1970	1975	1980	1985[1]	1990	1995	2000[1]	2004[2]
Carbon Monoxide (CO)	197.3	184.0	177.8	169.6	143.6	120.0	102.4	87.2
Nitrogen oxides (NOx)[3]	26.9	26.4	27.1	25.8	25.2	24.7	22.3	18.8
Particulate Matter (PM)[4]								
PM_{10}	12.2[1]	7.0	6.2	3.6	3.2	3.1	2.3	2.5
$PM_{2.5}$[5]	NA	NA	NA	NA	2.3	2.2	1.8	1.9
Sulfur dioxide (SO_2)	31.2	28.0	25.9	23.3	23.1	18.6	16.3	15.2
Volatile organic compounds (VOC)	33.7	30.2	30.1	26.9	23.1	21.6	16.9	15.0
Lead[6]	0.221	0.16	0.074	0.022	0.005	0.004	0.003	0.003
Totals[7]	**301.5**	**275.8**	**267.2**	**249.2**	**218.2**	**188.0**	**160.2**	**138.7**

U.S. EPA national air pollutant emissions estimates (fires and dust excluded) for criteria pollutants. (Source: USEPA, accessed Sept. 15, 2005, http://www.epa.gov/oar/airtrends/2005/econ-emissions.html)

NOTES:

[1] *In 1985 and 1996, the EPA refined its methods for estimating emissions. Between 1970 and 1975, the EPA revised its methods for estimating particulate matter emissions.*

[2] *The estimates for 2004 are preliminary.*

[3] *NOx estimates before 1990 include emissions from fires, which would represent a small percentage of the NOx emissions.*

[4] *PM estimates do not include condensable PM, or the majority of $PM_{2.5}$ that is formed in the atmosphere from "precursor" gases such as SO_2 and NOx.*

[5] *The EPA has not estimated $PM_{2.5}$ emissions before 1990.*

[6] *The 1999 estimate for lead is used to represent 2000 and 2003 because lead estimates do not exist for these years.*

[7] *$PM_{2.5}$ emissions are not added when calculating the total because they are included in the PM_{10} estimate.*