Health Consultation

Investigation into community complaints of manure odors near the

AV ROTH FEEDER PIG FACILITY
WAUZEKA, CRAWFORD COUNTY, WISCONSIN

Prepared by the
Wisconsin Department of Health Services

SEPTEMBER 30, 2009

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Summary

The Wisconsin Division of Public Health (DPH), in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR), and the U.S. Environmental Protection Agency (EPA), monitored air quality near the large-scale AV Roth Feeder Pig farm, in Wauzeka, Wisconsin. Air monitoring was conducted at a single downwind residential location over two, 2-week periods in late May to early July 2009. The objective was to obtain air concentration data for hydrogen sulfide, in response to odor complaints and community health concerns, and to evaluate whether exposure to hydrogen sulfide is occurring at levels of health concern for residents. The air monitoring data will help ensure that the community has the best information possible to safeguard its health.

Conclusion	DPH concludes that exposure to hydrogen sulfide in air at locations near the AV Roth Feeder Pig farm is not expected to harm people's health.
Basis for decision	Air monitoring indicates that hydrogen sulfide can at times be detected as an odor, but is not concentrated enough to be harmful.
Next steps	To protect community health and well-being: DHS recommends the adoption of best practices at the AV Roth farm to minimize any nuisance odors affecting neighbors.

Background

Site Description and History

The ATSDR, Region 5, was contacted in April 2008 by citizens concerned about possible loss of environmental quality associated with an expansion of the AV Roth Breeder Pig farm in rural southwestern Wisconsin (31961 Hummingbird Lane, Town of Wauzeka, Crawford County, Wisconsin, 53826, Township 7N, Range 4W, Section 2, SW1/4 of SE 1/4). The AV Roth farm maintains approximately 3,000 breeding sows that annually produce an estimated 60,000 piglets.

Demographics

The area surrounding the AV Roth farm is predominantly rural. The closest municipality is the Village of Wauzeka (population 768), which is located 4 miles west southwest of the farm. Aerial photos of the area suggest there are 20 residences within 1 mile of the farm. From this, the estimated population within 1 mile of the farm is between 30 and 60 people.

Community Health Concerns

Health concerns raised by community members at the time of the August 2008 and May 2009 meetings held by ATDSR and DPH included odors and air quality, impacts of quality of life,

groundwater quality related to manure spreading on farm fields, and concerns related to proposed expansions of the AV Roth farm operations. The normal routes of exposure to environmental contaminants related to manure storage and spreading are via impacts to air quality and impacts to groundwater. The focus of this consultation is on air quality, since concentrated animal feeding operations (CAFOs) are regulated separately, to protect groundwater and surface water, under rules administered by the Wisconsin Department of Natural Resources (WDNR) and local entities (see Wisc. Administrative Code, ch. NR 243). Since the issue of groundwater quality was raised, DPH emphasized that community residents operating private wells should follow the standard practice of having their wells tested annually for coliform bacteria and nitrates, or whenever there is a change in the odor, appearance, or taste of the water.

Site Visits and Investigation

ATSDR and DPH staff met with a group of neighbors of the Roth farm on August 14, 2008, visiting a total of 4 residences and 7 individuals. Another meeting with neighbors and with representatives from the WDNR and the Wisconsin Department of Agriculture, Trade, and Consumer Protection (DATCP) was held on May 26, 2009. On that date, the various agency representatives met separately with Mr. AV Roth to learn more about his farm operation and to discuss the concerns raised by his neighbors.

There are approximately 17 houses located within 3300 feet of the Roth farm. The local citizens reported intermittent manure odors that they associated with the Roth farm; these varied with the time of day and daily wind conditions. A completed exposure pathway exists for the inhalation of H2S. At the time of the two site visits, ATSDR and DPH did not note any manure odors, even when within 100 feet of buildings housing hogs. However, since daily conditions may vary, and because the expansion of the farm is locally controversial, ATSDR and DPH agreed to follow up with air monitoring.

In Wisconsin, the siting of CAFOs is regulated under local zoning codes along with Wisconsin Statute 93.90, the state livestock facility siting law. In recent years, nuisance complaints and land use conflicts related to large confinement operations have increased (Hansen 2002). Under Wisconsin Statute 823.08, also known as the *Right to Farm Law* (Leg. Ref. Bureau 2009):

> An agricultural use or an agricultural practice may not be found to be a nuisance if all of the following apply:
> 1. The agricultural use or agricultural practice alleged to be a nuisance is conducted on, or on a public right−of−way adjacent to, land that was in agricultural use without substantial interruption before the plaintiff began the use of property that the plaintiff alleges was interfered with by the agricultural use or agricultural practice.
> 2. The agricultural use or agricultural practice does not present a substantial threat to public health or safety.

In light of the existing agricultural nuisance law, DPH sought to determine whether air quality near the A.V. Roth farm presented a public health hazard or concern. Emissions from manure stockpiles and wastewater lagoons represent a broad mixture of chemicals. Of these, ammonia

and hydrogen sulfide (H_2S) typically present the greatest potential health concern in terms of their predominant concentration and toxicity among manure volatiles from hog, dairy, and poultry livestock confinements. A recent report (ATSDR 2009) concluded that hydrogen sulfide emissions from the Excel Dairy in Minnesota were a public health hazard, and other reports (Wing *et al.* 2009) have used hydrogen sulfide as an air quality indicator near hog confinements. Consequently, DPH chose to monitor hydrogen sulfide at a location downwind of the Roth farm.

Hydrogen sulfide monitoring. DPH placed a Honeywell Single Point Monitor fitted with a hydrogen sulfide Chemcassette® and a Modulogger® data logging system near the site. Technical support and training for the equipment was provided by EPA. The equipment was placed in a farm shed on the property of the closest downwind neighbor, as indicated from weather records (www.wunderground.com, not shown) for the Boscobel airport, ca. 8 miles northeast of the Roth farm . The location was chosen on the basis of access, proximity, and wind direction. The monitoring location was approximately 1950 feet at a direction of 62º from a wastewater lagoon on the Roth farm (Figure 1). The equipment was set to operate continuously with one reading every 5 minutes for 27 days covering May 26-June 9, 2009 and June 18-July 1, 2009. The neighbors had indicated that late spring to early summer was the time when the worst odors had been noticed in previous years.

Results of air monitoring. Over the course of the 14 day and 13 day monitoring intervals, the three highest H_2S measurements were 14.1, 11.2, and 10.6 parts-per-billion, or ppb (Table 1, Figures 1, 2). These occurred on June 3, June 26, and June 26, respectively. As shown in Figures 1 and 2, measurable H_2S persisted at times for several hours, but the duration of the peak measurements was less than 10 minutes. The average H_2S measured during May 26-June 9 was 0.31 ± 0.01 ppb (mean ± standard error), with an average temperature of 62.3 ºF. The average H_2S during June 18-July 1 was 0.33 ± 0.2 ppb, with an average temperature of 75.4 ºF.

Discussion

During the 27 days of air monitoring, the levels of hydrogen sulfide in air downwind of the A.V. Roth Feeder Pig Farm were not measured at a level representing either an acute or chronic exposure concern. The data (Figures 1, 2) indicate that manure odors are at times noticeable, particularly around 7-9 a.m. and in the late evening (Table 1). On two days (June 20 and 26) H_2S was present above 2 ppb for much of the day.

Individual responses to low levels of volatile chemicals in air vary. A wide range of odor threshold values for H_2S have been reported in the literature. AIHA (1989) reports a range among scientifically acceptable published studies of 1-130 ppb, and a mean recognition odor threshold of 4.5 ppb.

Toxicology of Hydrogen Sulfide. Hydrogen sulfide (H_2S) is a gas often produced during the microbial reduction of sulfates in biological waste, waste from enteric sources, as a byproduct of petroleum refining, or the degradation of demolition landfills containing gypsum or other materials having high sulfur content.

At low levels, H_2S causes nuisance odors. As concentrations increase, odors may be less evident due to olfactory paralysis. In the environment, H_2S is typically present at about 0.2 ppb. By

about 300 ppb H_2S, is detectable as an offensive "rotten egg" odor that becomes very offensive by 3000-5000 ppb. At about 2000 ppb, asthmatics are affected, and olfactory paralysis ensues at about 150,000 ppb. The lack of a perceived odor contributes to the occurrence of fatal exposures to H_2S in confined spaces such as sewers and manure pits. In cases of accidents involving acute H_2S exposures, the actual concentration is usually unknown. Concentrations greater than 500,000 ppb for less than one hour can cause central nervous system depression, loss of consciousness, and persistent neurological problems upon recovery. Concentrations above 600,000-1,000,000 ppb can cause lung paralysis, physical collapse, and death (ATSDR 1998).

Despite the well-documented toxicity of H_2S at sufficient environmental concentration, several studies (*e.g.* Abe and Kimura 1996, Hosoki *et al.* 1997, Whiteman *et al.* 2005, Zhang *et al.* 2006) report a possible endogenous role for H_2S as a neuromodulator and smooth muscle relaxant, noting that it is produced in the body, selectively enhances NMDA receptor-mediated responses, is present at fairly high levels in the brain, and is present at lower brain concentrations in Alzheimer's patients.

Objective environmental measurements of malodor related to swine CAFOs have been reported elsewhere (*e.g.* Wing *et al.* 2008). Malodors can be traced to a variety of manure-related chemical classes in addition to H_2S, including ammonia, amines, organic acids, alcohols. Although toxic levels of H_2S were not noted here, this does not exclude the effect of nuisance odors on quality of life.

Regulatory perspective. For exposures in the workplace, the federal Occupational Safety and Health Administration (OSHA) has set an acceptable ceiling limit for hydrogen sulfide of 20 parts per million (or 20,000 parts per billion) in the workplace.

The release of H_2S in Wisconsin as a hazardous air pollutant is regulated under ch. NR 445, Wis. Adm. Code. The acceptable ambient concentration for hydrogen sulfide is 335 micrograms per cubic meter (335 $\mu g/m^3$ or 240 ppb), on a 24-hour average basis. See appendix I (WDNR, under review) for a more detailed description of Wisconsin's Livestock Siting Law with regard to odor standards.

Health-based Comparison Values used by ATSDR are concentrations of environmental toxicants used for screening purposes, below which no health effects are expected, even among sensitive individuals. For hydrogen sulfide, the acute Minimum Risk Level (MRL) of 70 ppb is based on effects among asthmatic individuals who were exposed to 2,000 ppb hydrogen sulfide for 30 minutes. The intermediate MRL of 20 ppb is based on toxicity to olfactory neurons in exposed laboratory animals (ATSDR 1998; 2009a; 2009b). The highest H_2S level measured during this investigation was 14.2 ppb, which is below the ATSDR screening value for H_2S. The average results for the total sampling period are less than the EPA reference concentration of 1 ppb. Based upon these comparisons, the measured levels of H_2S, which may be intermittently noticeable as an odor, are not likely to harm people's health.

Child Health Considerations

In communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than are adults from certain kinds of exposure to hazardous substances. Children play outdoors and

sometimes engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than are adults; this means they breathe dust, soil, and vapors close to the ground. A child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus adults need as much information as possible to make informed decisions regarding their children's health.

Health effects on children specific to hydrogen sulfide have been little studied, but are expected to be similar to effects on adults (ATSDR 1998). Similarly, children often perceive and regard odors differently than adults, but predictions with regard to the effect of manure odors are not possible.

Hazard Conclusion

Introduction For the rural area near the AV Roth farm, DPH's priority is to ensure that the community has the best information possible to safeguard its health.

Conclusion DPH concludes that exposure to hydrogen sulfide in air at locations near the AV Roth Feeder Pig farm is not expected to harm people's health. Air monitoring indicates that hydrogen sulfide can be detected as an odor, but is not concentrated enough to be harmful.

Recommendations

Both CAFOs and conventional livestock farms, if poorly managed, can cause environmental damage and present an odor nuisance to neighbors. To protect community health and well-being:

- DHS recommends that the AV Roth farm continue to follow the guidance and oversight of state and local agricultural and environmental agencies, and to use and adopt best practices to minimize any nuisance odors affecting neighbors and avoid environmental damage to groundwater or surface water.

Public Health Action Plan

Public health actions that have been taken include:

- DPH and ATSDR conducted several formal and informal meetings and discussions with neighbors of AV Roth farm.
- DPH and ATSDR conducted 28 days of air monitoring for hydrogen sulfide at a location downwind of the AV Roth farm.
- DPH, ATSDR, and representatives from other environmental and agricultural agencies met with Mr. AV Roth to discuss his farm operation, community concerns, and to provide information on current best farming practices.
- Preliminary results of the monitoring have been informally shared with community members.

Future actions:

- The completed health consultation will be distributed to the community.
- If requested, DPH is available to meet with community members to discuss the health consultation.
- DPH does not plan to conduct more air monitoring near the AV Roth farm at this time.
- DPH will continue to study environmental health issues associated with CAFOs in Wisconsin, and will continue to work with the WDNR and the DATCP, which are the lead state agencies that develop policies and rules that guide and regulate CAFOs.
- DPH has been informed of planned changes in manure handling and storage at the farm that are expected to reduce odor emissions from the facility. These include closing two manure storage lagoons and switching to a manure storage pit beneath a new barn. The changes are necessary to obtain local approval for the facility and to meet the state siting standards. In addition, closing the two pits also allowed the facility to meet the odor standard.

Author

Robert Thiboldeaux, PhD
Toxicologist
Division of Public Health
Wisconsin Department of Health Services

Technical Advisors

Michelle A. Colledge MPH, PhD
LCDR, U.S. Public Health Service
Agency for Toxic Substances and Disease Registry/NCEH/CDC, Region 5

Ramon C. Mendoza,
On Scene Coordinator
USEPA Region 5

David Grande
Bureau of Air Management
Wisconsin Department of Natural Recourses

Mike Murray
Bureau of Land and Water Resources
Wisconsin Department of Agriculture, Trade, and Consumer Protection

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Tables

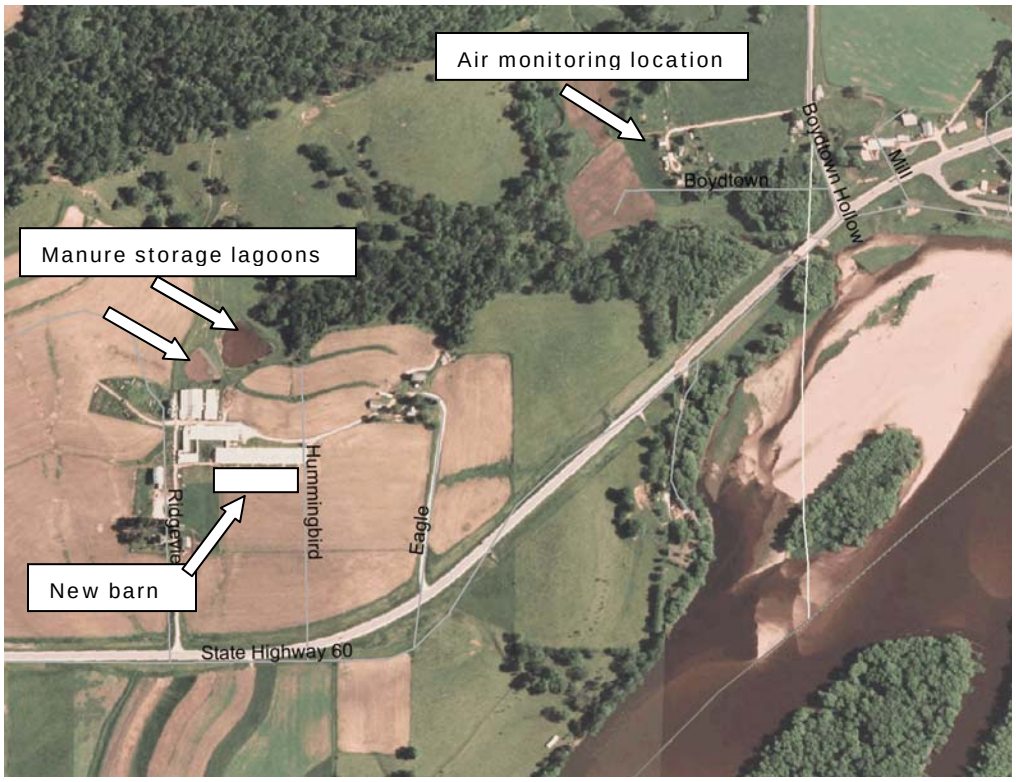
Table 1: Description of Hydrogen sulfide (H_2S) peaks shown in Figures 1 and 2.

Date* m/d/2009	Time interval	Maximum H_2S during interval ppb
5/29	6:54-10:04	3.5
5/30	9:04-9:14	2.5
5/31	7:24-9:09	4.2
6/01	7:34-8-44	2.8
6/02	17:04-17:14	6.0
6/03	21:29-21:39	5.9
6/03	22:14-22:24	14.1
6/04	7:48-8:59	2.5
6/05	7:19-9:39	3.8
6/07	14:19-14:29	2.1
6/18	12:52-12:45	4.6
6/20	7:20-8:15	5.0
6/21	10:45-14:55	2.5
6/22	9:40-9:50	2.1
6/23	8:20-10:30	3.5
6/24	7:00-8:05	4.2
6/25	7:35-12:35	6.7
6/25	14:10-15:05	4.6
6/25	21:00-21:05	3.8
6/25	23:40-23:50	6.7
6/26	1:30-14:45	11.2

*First monitoring period = May 26-June 9 2009. Second monitoring period = June 18-July 1, 2009.

Figures

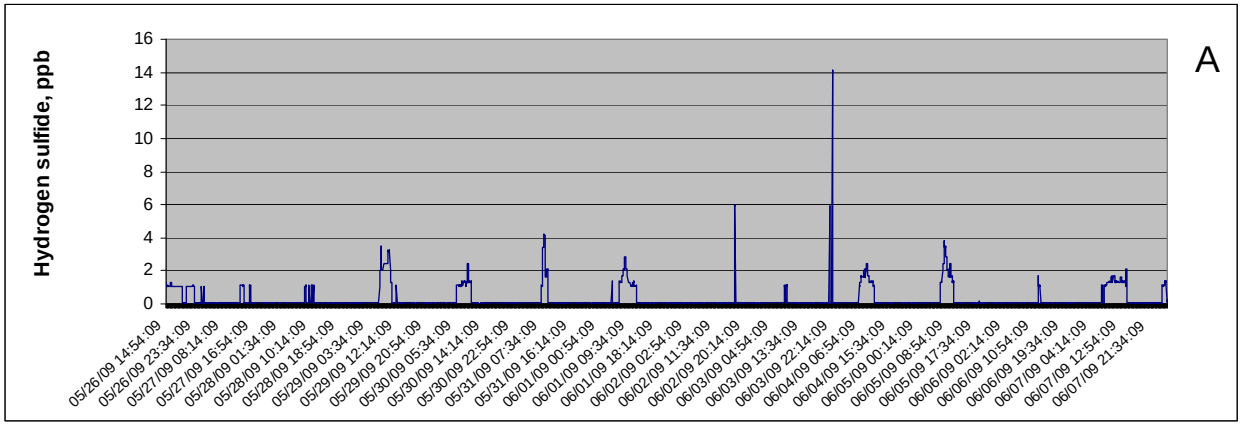
Figure 1. Aerial view of A.V. Roth Feeder Pig farm, and neighboring areas.

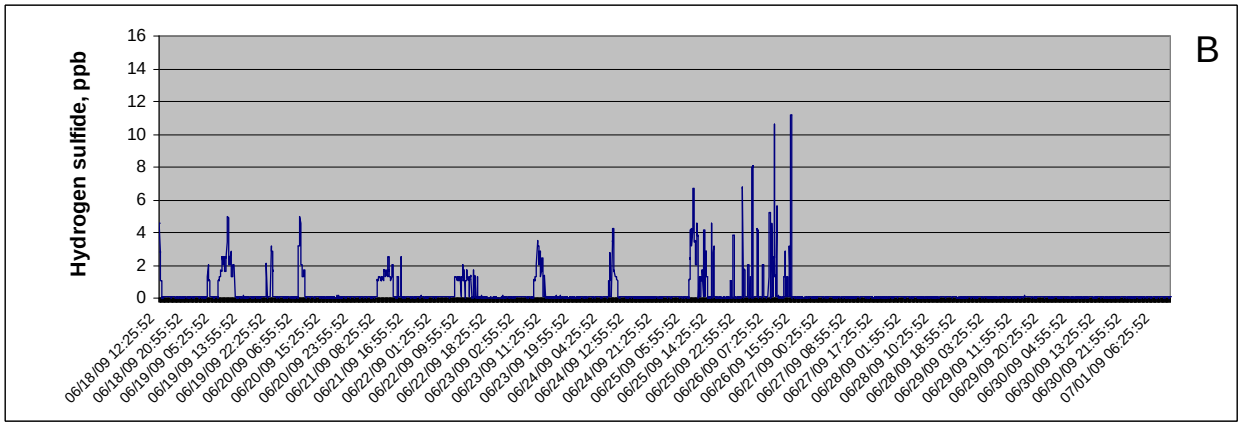


Location: 31961 Hummingbird Lane Wauzeka, WI 53826, Township 7N, Range 4W, Section 2, SW1/4 of SE ¼.

Prepared using WI DNR *GIS Webview*. http://www.dnr.state.wi.us/maps/gis/appwebview.html

Figure 2. Hydrogen sulfide concentration in air 1950 feet downwind of the AV Roth Feeder Pig farm versus date and time, measured over two monitoring intervals. A: **First monitoring period = May 26-June 9 2009;** B: **Second monitoring period = June 18-July 1, 2009. ppb: parts per billion.**





Appendix I

Excerpt from: FINAL REPORT ON WISCONSIN'S DAIRY AND LIVESTOCK ODOR AND AIR EMISSION PROJECT SUPPORTED BY USDA NRCS CONSERVATION INNOVATION GRANT

NRCS 68-3A75-5-157 WI DAIRY AND LIVESTOCK AIR EMISSION/ODOR PROJECT

September 2009

Madison, Wisconsin

P. 17-18

REGULATORY DRIVERS

Several regulations at the state and local level are driving a need for scientific study and evaluation of ambient air concentrations. Hazardous air pollutant emissions are regulated under ch. NR 445, Wis. Adm. Code. This rule establishes ambient air standards for specific hazardous air pollutants, off the source's property. The acceptable ambient concentration standards for ammonia and hydrogen sulfide are 418 and 335 micrograms per cubic meter, respectively, both on a 24-hour average basis.

NR 445, Wis. Adm. Code was updated in 2008 to extend an exemption period for livestock operations to July 31, 2011. Existing livestock operations are required to achieve compliance by July 31, 2011. After July 31, 2011, new livestock operations are required to comply upon start up. The rule provides several compliance options. A special compliance option for livestock operations is established in the rule, specifically, the implementation of best management practices as approved by the Department of Natural Resources. This study was designed in part to provide information to support department decisions on best management practices for the control of hazardous air pollutant emissions, as proposed under this rule.

There is increasing attention placed on the impact of livestock operations on odor and ambient air concentrations. Wisconsin has promulgated NR 445, Wis. Adm. Code, Control of Hazardous Pollutants. This code establishes best management practices as the method to secure compliance for emission sources involving agricultural waste. Implementation is delayed until July 31, 2011 to allow development of the BMPs to regulate and control emissions from these sources. Wisconsin is experiencing increased conflicts between livestock operations and developing rural communities related to odor and water quality issues.

A number of local governments are regulating the location and expansion of livestock operations through local zoning and issuing of conditional use permits. In 2003, Wisconsin passed the Livestock Facility Siting Law, and in 2006, promulgated ATCP 51, Wis. Adm. Code, to implement the law. The state developed an odor standard to estimate the impact of various farming practices on odor. Since this is the first attempt to set statewide standards related to odors, the effort was relatively controversial. The issue of whether livestock operations are a threat to public health and welfare will continue, especially as the livestock industry transitions to larger size operations.

Parameters of Interest

There are literally hundreds of volatile compounds that have been found associated with manures. Of these, quite a few are listed in NR445. Choosing which parameters to include within

this study was a process which balanced the available budget with the existence of testing methods, the perceived likelihood that any particular compound might actually be present in levels approaching those listed in NR445, and the probability that the presence of the compounds is actually associated with the agricultural operation.

Based on these factors, this study focuses on ammonia and hydrogen sulfide as the compounds most likely to be present at almost all farms. Several other compounds that are likely to be present (such as benzene and formaldehyde) were rejected because of their ubiquitous occurrence in the atmosphere, and thus the difficulty of associating their presence with the operation in question. While ammonia and hydrogen sulfide have other sources, both natural and anthropogenic, their concentrations in the vicinity of farms will most likely be driven by the farm itself.

Ammonia is a by-product of the decay of urea, and is present around the urine of all animals. Hydrogen sulfide is a product of the anaerobic decay of organic materials, which in the case of animal feeding operations is the manure.

CERTIFICATION

This Health Consultation was prepared by the Wisconsin Department of Health Services under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun. Editorial review was completed by the Cooperative Agreement partner.

Jennifer Freed
Technical Project Officer
CAT, CAPEB, DHAC, ATSDR

Alan Yarbrough
Team Lead
CAT, CAPEB, DHAC, ATSDR