

BEFORE THE UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY

ENVIRONMENTAL INTEGRITY PROJECT, ASSOCIATION OF IRRITATED RESIDENTS, CABALLO CONCERNED CITIZENS GROUP, CENTER FOR FOOD SAFETY, CITIZENS FOR PENNSYLVANIA'S FUTURE, CLEAN WISCONSIN, CRAWFORD STEWARDSHIP PROJECT, ENVIRONMENTALLY CONCERNED CITIZENS OF SOUTH CENTRAL MICHIGAN, FOOD & WATER WATCH, THE HUMANE SOCIETY OF THE UNITED STATES, ILLINOIS CITIZENS FOR CLEAN AIR AND WATER, IOWA CITIZENS FOR COMMUNITY IMPROVEMENT, JOHNS HOPKINS CENTER FOR A LIVABLE FUTURE, MIDWEST ENVIRONMENTAL ADVOCATES, NORTHWEST ENVIRONMENTAL DEFENSE CENTER, RIO VALLE CONCERNED CITIZENS, SIERRA CLUB, SOCIALLY RESPONSIBLE AGRICULTURAL PROJECT, SUSTAIN RURAL WISCONSIN NETWORK, VERNON COUNTY ALLIANCE CONCERNED WITH ENVIRONMENTAL SAFETY, AND WATERKEEPER ALLIANCE,

Petitioners

v.

LISA P. JACKSON, ADMINISTRATOR
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY,

Respondent.

**PETITION FOR THE REGULATION OF AMMONIA AS A CRITERIA
POLLUTANT UNDER CLEAN AIR ACT SECTIONS 108 AND 109**

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I. EXECUTIVE SUMMARY

Congress enacted the Clean Air Act (CAA) to protect public health from diverse sources of air pollution, and empowered the Environmental Protection Agency (EPA) to establish regulations for different pollutants as scientific knowledge evolves, and the dangers they pose to human health and welfare become apparent. As this petition will establish, ambient ammonia pollution currently endangers human health and welfare, and EPA has an affirmative obligation to exercise its authority to regulate sources of ammonia emissions.

Ammonia gas, an air pollutant emitted in vast quantities by Concentrated Animal Feeding Operations (CAFOs), meets the criteria for listing as a CAA criteria pollutant, because ammonia emissions from numerous CAFOs and other sources “cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare.” CAA § 108. The predominantly rural nature of this pollution does not limit EPA’s authority to regulate; in fact, courts have made clear that even localized, site-specific, and infrequent ambient air pollution may create a public health risk that meets the § 108 standard and therefore warrants CAA regulation.

Several federal agencies, including EPA, have documented ammonia’s acute and chronic adverse health effects. Numerous peer-reviewed studies further demonstrate that ambient ammonia pollution in some rural communities near CAFOs currently exceeds recommended exposure levels, and citizens living near CAFOs experience adverse health effects from CAFO air pollution, including ammonia. Ammonia gas also reacts with other gases to form ammonium aerosols, inhalable small particles that further endanger public health.

This petition will also establish that ambient ammonia pollution endangers public welfare, which the CAA defines broadly to include quality of life, economic, aesthetic, and environmental values. Ammonia emissions detract from quality of life and decrease personal comfort and well-being in rural areas. Airborne ammonia re-deposits in and near waterways, adding nitrogen to ecosystems overloaded with nutrient pollution, reduces property values, and impairs visibility in scenic areas. The petitioners respectfully request that EPA issue a timely response to this petition, make an endangerment finding for ammonia, designate ammonia as a criteria pollutant, and establish primary and secondary National Ambient Air Quality Standards (NAAQS) to protect public health and welfare with an adequate margin of safety.

II. INTRODUCTION

The Environmental Integrity Project, Association of Irrigated Residents, Caballo Concerned Citizens Group, Center for Food Safety, Citizens for Pennsylvania’s Future, Clean Wisconsin, Crawford Stewardship Project, Environmentally Concerned Citizens of South Central Michigan, Food & Water Watch, the Humane Society of the United States, Illinois Citizens for Clean Air and Water, Iowa Citizens for Community Improvement, Johns Hopkins Center for a Livable Future, Midwest Environmental Advocates, Northwest Environmental

Defense Center, Rio Valle Concerned Citizens, Sierra Club, Socially Responsible Agricultural Project, Sustain Rural Wisconsin Network, Vernon County Alliance Concerned with Environmental Safety, and Waterkeeper Alliance (petitioners) hereby petition the EPA to regulate air emissions of ammonia (NH₃) as a criteria pollutant under the CAA, sections 108 and 109.¹ Ammonia meets the legal standard for listing as a criteria pollutant because numerous stationary sources currently emit ammonia, an air pollutant, into the ambient air at levels which may reasonably be anticipated to endanger public health and welfare.

Ammonia qualifies as a pollutant that endangers public health and welfare. Exposure to airborne ammonia can cause both short-term and chronic respiratory health effects, and the chemical is lethal at sufficiently high concentrations. In addition, ammonia re-deposits onto soils and into sensitive waterways, resulting in soil acidification and eutrophication, which are destructive to both terrestrial and aquatic ecosystems. The small particles ammonia forms in combination with other pollutants contribute to regional haze and further threaten public health, and ammonia's odor adversely affects quality of life and property values.

While ammonia sources that exceed certain thresholds must report emissions under federal "right to know" laws,² the CAA currently does not meaningfully regulate ammonia emissions from the nation's most significant sources. The CAA, EPA's most appropriate and effective tool for regulating air emissions, does not include ammonia on either its list of hazardous air pollutants, established in § 112, or its list of criteria pollutants, established pursuant to §§ 108 and 109; nor does it establish New Source Performance Standards under § 111 for CAFOs, the industry sector responsible for the majority of U.S. ammonia emissions.

The health and welfare harms caused by ambient ammonia warrant EPA's increased scrutiny and regulation. Although additional CAA programs likely apply to ammonia and other CAFO emissions, EPA should regulate ammonia as a criteria pollutant, because short-term and chronic ambient ammonia pollution threatens public health and welfare in rural communities throughout the U.S. Due to ammonia's toxicological profile and the human health and ecological threats it poses, the petitioners submit this petition to EPA, requesting that the agency list ammonia as a criteria pollutant and issue primary and secondary NAAQS to protect public health and public welfare from ammonia pollution.

¹ 42 U.S.C. §§7408, 7409.

² EPA recently limited these emissions reporting requirements as well. Under EPA's 2008 CERCLA/EPCRA Administrative Reporting Exemption for CAFOs, only the Emergency Planning and Community Right to Know Act (EPCRA) still requires reporting of ammonia and hydrogen sulfide emissions from CAFOs, and only by large CAFOs as defined under the Clean Water Act. *See* CERCLA/EPCRA Administrative Reporting Exemption for Air Releases of Hazardous Substances From Animal Waste at Farms, 73 Fed. Reg. 76,948, 76,951 (Dec. 18, 2008).

III. PETITIONERS

The petitioners are the Environmental Integrity Project, Association of Irrigated Residents, Caballo Concerned Citizens Group, Center for Food Safety, Citizens for Pennsylvania's Future, Clean Wisconsin, Crawford Stewardship Project, Environmentally Concerned Citizens of South Central Michigan, Food & Water Watch, the Humane Society of the United States, Illinois Citizens for Clean Air and Water, Iowa Citizens for Community Improvement, Johns Hopkins Center for a Livable Future, Midwest Environmental Advocates, Northwest Environmental Defense Center, Rio Valle Concerned Citizens, Sierra Club, Socially Responsible Agricultural Project, Sustain Rural Wisconsin Network, Vernon County Alliance Concerned with Environmental Safety, and Waterkeeper Alliance.

The Environmental Integrity Project (EIP) is a nonpartisan, nonprofit organization established in March of 2002 by former EPA enforcement attorneys to advocate for more effective enforcement of environmental laws. CAFO pollution, one of EIP's focal issues, contributes a controlling share of the total ammonia air emissions in the United States. EIP has an interest in protecting the environment from ammonia emissions released from CAFOs and other sources, as these emissions threaten human health and welfare, air quality, and water quality.

The Association of Irrigated Residents (AIR) is an unincorporated non-profit with members throughout the San Joaquin Valley (SJV). On the basis of air quality issues, AIR has fought the local growth in dairy CAFOs in the SJV. For many years AIR has requested that the San Joaquin Valley Air Pollution Control District regulate ammonia as a precursor to PM_{2.5} or ammonium nitrate. Wintertime PM_{2.5} levels in Kern County, at the southern end of the SJV, are the worst in the nation.

Caballo Concerned Citizens Group (CCCG) is a grassroots community group of more than 1,000 New Mexicans. CCCG formed in response to a mega-dairy that attempted to locate in a region with shallow groundwater and vulnerable artesian wells, and within dangerous proximity to the Caballo Reservoir, the Rio Grande River, and pristine state parks. CCCG members living near animal factories cannot drink water from their wells or breathe the air in their homes due to these facilities' unregulated pollution, including ammonia.

Established in 1997, The Center for Food Safety (CFS) is a non-profit, membership organization that works to protect human health and the environment by curbing the proliferation of harmful food production technologies and by promoting organic and other forms of sustainable agriculture. CFS represents over 160,000 members throughout the country that are concerned about the impacts of factory farming on human health, animal welfare, and the environment. CFS believes that EPA must regulate ammonia and other pollutants from factory farms in order to protect human health and the environment and create a healthier, safer food supply.

Citizens for Pennsylvania's Future (PennFuture) works for a healthy environment, clean energy, and a sound economy. PennFuture litigates and advocates sound statewide policies to reduce air pollution from all sources, including agriculture.

Clean Wisconsin protects Wisconsin's clean water and air and advocates for clean energy by being an effective voice in the state legislature and by holding elected officials and polluters accountable. Clean Wisconsin's mission is to protect the special places that make Wisconsin such a wonderful place to live, work and play.

Crawford Stewardship Project is a grassroots community organization that works to protect the environment of Crawford County, Wisconsin from threats such as those posed by CAFOs and to promote sustainable land use, local control of natural resources, and environmental justice.

Environmentally Concerned Citizens of South Central Michigan (ECCSCM) supports vanguard, responsible agriculture, farming that looks ahead to the next generations, preserves biodiversity, raises animals in a healthy environment, does no harm to its neighbors, enhances the natural assets of living communities, and protects our natural resources – air, soils, groundwater, streams, and lakes. As family farmers and neighbors, ECCSCM believes agriculture must take responsibility for its actions in rural communities. CAFOs have failed us. They have damaged our farming communities, degraded our natural resources, and polluted our watersheds. ECCSCM believes that ammonia must be regulated to protect our communities, young and old.

Food & Water Watch is a national nonprofit advocacy organization that advocates for common sense policies that will result in healthy, safe food and access to safe and affordable drinking water. The issue of industrialized livestock production is a core part of Food & Water Watch's work. Food & Water Watch has worked since 2005 to change federal and state policy on CAFOs and also works to educate the public on the variety of impacts these facilities have on public health and the environment.

The Humane Society of the United States (HSUS) is a national and international non-profit charitable organization that works to reduce suffering and improve the lives of all animals. The HSUS maintains its headquarters in Washington, D.C., and has offices, affiliates, or staff in 25 states, the District of Columbia, and five foreign countries. Through its policy, legislative, litigation, and grass-roots activities, the HSUS has become the nation's largest and most effective animal protection organization, with more than 11 million members and constituents. The HSUS actively advocates against practices that harm all animals, including practices that result in unhealthy levels of pollutants being discharged into farm animal and wildlife habitats. HSUS has actively campaigned to regulate air pollutants being discharged by CAFOs through efforts with the EPA, in Congress, and in the Courts. Members of HSUS in the Lathrop, California community teamed up with the HSUS to bring a suit against a large chicken CAFO

that emits toxic levels of ammonia into their neighborhood and HSUS has petitioned the EPA to list and regulate CAFOs under the Clean Air Act. In the course of HSUS cases, experts have documented ambient ammonia levels above recommended health limits in the local community.

Illinois Citizens for Clean Air and Water (ICCAW) is a state-wide coalition of family farmers and community groups advocating for sound policies and practices that protect the environment, human health, and rural quality of life from the impacts of large-scale, industrialized livestock production facilities in Illinois. A majority of its members are family farmers and rural residents that live near large-scale livestock facilities that have been adversely impacted by the problems they create. The regulation of ammonia emissions from CAFOs is of particular concern to ICCAW because of the human health risks neighbors experience from exposure.

Iowa Citizens for Community Improvement (Iowa CCI) is a 36-year-old statewide non-profit grassroots organization. Iowa CCI has led the fight against factory farms in Iowa for the past 15 years and has pushed for better environmental and permitting laws for factory farms on the state and national level – including the first clean air standards established for ammonia and hydrogen sulfide in the state of Iowa.

The Johns Hopkins Center for a Livable Future, based at the Bloomberg School of Public Health, conducts and funds research that increases knowledge about the complex interactions among diet, health, food production and the natural environment. The Center has over a decade of experience researching the public health impacts of industrial food animal production. Research has provided strong evidence that the complex mixtures of AFO air pollutants impact health of surrounding communities. The release of ammonia from these facilities and from land applied animal waste contributes to population exposures. Given this, there is strong justification for EPA to add ammonia as a criteria pollutant and develop ambient standards aimed at protecting public health.

Midwest Environmental Advocates (MEA) is a non-profit environmental law center, founded in 1999, which provides legal services for the under-represented and advocates for the public's right to clean air, land and water. MEA represents communities negatively affected by air and water pollution, including ammonia pollution, from CAFOs. MEA's clients have experienced many of the health impacts associated with ammonia including respiratory problems, dizziness, nausea, and burning eyes.

The Northwest Environmental Defense Center (NEDC) is an independent, nonprofit organization working to protect the environment and natural resources of the Pacific Northwest. NEDC has an interest in protecting the region's air quality and water quality from CAFO ammonia pollution. For example, NEDC has worked to protect the environment of the Columbia River Gorge, where ammonia emissions from CAFOs have contributed to haze.

Rio Valle Concerned Citizens (RVCC) is a community group organized by citizens in 2010, and is part of a New Mexico Dairy Coalition that works to protect the state's groundwater from dairy pollution. As a community living near a CAFO, RVCC has an interest in bringing ammonia pollution down to a safe level. RVCC believes that CAFOs should monitor the amount of ammonia they emit and the health effects our community residents are living with because of ammonia pollution, and be responsible for reducing ammonia pollution to a safe level.

Since 1892, the Sierra Club has been working to protect communities, wild places and the planet. With 1.4 million members and supporters, it is the largest grassroots environmental organization in the United States. The Sierra Club has long been involved in public education, advocacy and litigation to reduce pollution from CAFOs.

Socially Responsible Agricultural Project (SRAP) is a unique organization dedicated to assisting rural communities facing economic strife to help them discover local solutions which will help them thrive once again. Established in 1997, this nonprofit organization has assisted over 750 communities and groups in the United States and Canada that have been impacted by the negative effects of industrial agriculture.

Sustain Rural Wisconsin Network (SRWN) is a statewide coalition of organizations and individuals working together to understand and influence impacts of CAFOs on rural Wisconsin communities. SRWN supports actions to promote environmentally sound, socially responsible farming practices that assure clean air and water and safe local food production for the future. SRWN also works to encourage the diversity and vitality of Wisconsin's rural family farms and communities.

Vernon County Alliance Concerned with Environmental Safety (ACES) successfully organized to protect its community from a 3,200 head factory dairy proposed by an out-of-state developer. ACES' mission is to ensure that the environment, economy, and health are preserved and protected in the design and location of business and industry in Vernon County, Wisconsin.

Waterkeeper Alliance is an international nonprofit organization representing the interests of its nearly 200 member watershed groups. Waterkeeper, along with each of its member groups, is dedicated to the preservation and protection of waterbodies and their neighboring communities. Aligned with this mission, Waterkeeper is concerned with the impacts of concentrated animal production on public health and the environment, and it seeks to reduce these impacts by actively advocating for the control of animal waste pollution, and for the promotion of sustainable agriculture.

IV. LEGAL AUTHORITY FOR REGULATING AMMONIA

The CAA provides EPA with the legal authority required to regulate ammonia. Congress directed EPA to designate pollutants that endanger public health or welfare as criteria pollutants, and to establish protective primary and secondary National Ambient Air Quality Standards for these pollutants, under §§ 108 and 109 of the CAA.

Section 108 sets out the requirements for establishing and regulating criteria pollutants:

- (a) Air Pollutant List; publication and revision by Administrator; issuance of air quality criteria for air pollutants
 - (1) For the purpose of establishing national primary and secondary ambient air quality standards, the Administrator shall within 30 days after December 31, 1970, publish, and shall from time to time thereafter revise, a list which includes each air pollutant---
 - (A) emissions of which, in his judgment, cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare;
 - (B) the presence of which in the ambient air results from numerous or diverse mobile or stationary sources; and
 - (C) for which air quality criteria had not been issued before December 31, 1970, but for which he plans to issue air quality criteria under this section.

This petition will demonstrate that ammonia meets all of the CAA statutory requirements for regulation under § 108 because: 1) it is a pollutant, 2) emissions of which may reasonably be anticipated to endanger public health and welfare, 3) the presence of which results from numerous stationary sources (primarily CAFOs), and 4) for which no air quality criteria have been issued.

Once EPA lists a pollutant under § 108, the listing triggers § 109, which sets the schedule for promulgating NAAQS³ and requires EPA to establish primary and secondary standards sufficient to protect public health and welfare. EPA has only designated six criteria pollutants: 1) carbon monoxide, 2) nitrogen dioxide, 3) ozone, 4) lead, 5) sulfur dioxide, and 6) particulate matter (both PM_{2.5} and PM₁₀). However, the wording of § 109(d), which requires EPA to review the NAAQS every five years and “promulgate such new standards as may be appropriate in accordance with section 7408 [108],” makes clear that Congress anticipated the list should evolve as new scientific studies emerge and new pollutants qualify for listing. Furthermore,

³ Section 109 states “[n]ot later than December 31, 1980, and at five-year intervals thereafter, the Administrator shall complete a thorough review of the criteria published under section 7408 of this title and the national ambient air quality standards promulgated under this section and shall make such revisions in such criteria and standards and promulgate such new standards as may be appropriate in accordance with section 7408 of this title and subsection (b) of this section. The Administrator may review and revise criteria or promulgate new standards earlier or more frequently than required under this paragraph.” CAA § 109(d)(1).

courts have established that § 109(d) gives rise to a mandatory duty for EPA to regulate a pollutant once it satisfies the statutory requirements of § 108.⁴

Under §109(d), the Administrator and independent scientific review committee must re-evaluate both the list of criteria pollutants and the NAAQS in five-year intervals, but may promulgate new standards more frequently in its discretion. Due to ammonia's ongoing adverse effects on public health and welfare, the petitioners urge EPA to take prompt action in response to this petition.

V. EPA SHOULD REGULATE AMMONIA AS A CRITERIA POLLUTANT UNDER CAA SECTION 108

EPA should make an endangerment finding and designate ammonia as a criteria pollutant, because it meets the statutory requirements for regulation. Ammonia is a pollutant, emissions of which endanger public health and welfare, the presence of which results from numerous stationary sources (CAFOs), and for which no air quality criteria have been issued.

A. Ammonia meets the CAA definition of an air pollutant

CAA section 108(a)(1) only applies to the regulation of air pollutants. Ammonia clearly meets the CAA § 302(g) definition of an air pollutant: “any air pollution agent or combination of such agents, including any physical, chemical, biological, radioactive (including source material, special nuclear material, and byproduct material) substance or matter which is emitted into or otherwise enters the ambient air. Such term includes any precursors to the formation of any air pollutant, to the extent the Administrator has identified such precursor or precursors for the particular purpose for which the term ‘air pollutant’ is used.”

The term “air pollutant” has been given a broad and “sweeping” interpretation by the Supreme Court.⁵ Ammonia gas meets the CAA’s definition because, as this petition will establish, it causes harm to public health and the natural environment when numerous stationary sources, including CAFOs, steel mills, and refineries, emit it into the ambient air. EPA currently regulates airborne ammonia under CERCLA as a hazardous substance, and under EPCRA as an extremely hazardous substance,⁶ and the Agency for Toxic Substances and Disease Registry (ATSDR) characterizes ammonia as a toxin because exposure to airborne ammonia can result in severe respiratory effects. EPA also recognizes ammonia’s role as a fine particulate matter

⁴ See discussion *infra* Section VIII.

⁵ *Massachusetts v. EPA*, 549 U.S. 497 (2007) at 527. The court places emphasis on the use of the word “any” air pollutant.

⁶ 40 C.F.R. §§ 302.4–302.5, 355.40, App. A to § 355 (2008).

precursor pollutant.⁷ Thus ambient ammonia gas is air pollution, and ammonia emitted into the air is an air pollutant under the CAA.

B. Ammonia emissions cause and contribute to air pollution which may reasonably be anticipated to endanger both public health and welfare

Under CAA § 108(a)(1)(A), to qualify as a criteria pollutant, ammonia must cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare. This petition presents extensive evidence to support a finding that ammonia endangers both public health and public welfare, and that ammonia emissions from numerous stationary sources currently give rise to ambient ammonia concentrations harmful to human health and quality of life, soil and water quality, visibility, and property values.

1. Ammonia emissions endanger public health

The CAA requires EPA to establish NAAQS for an air pollutant if the agency determines that the pollutant can be reasonably anticipated to endanger public health. Although the CAA and its implementing regulations do not define public health, the Supreme Court has affirmed its broad and common sense meaning, declaring it as simply “the health of the public.”⁸ The World Health Organization has also established a widely accepted definition of health as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.”⁹ In addition, Black’s Law Dictionary (8th ed. 2004) defines both health: it defines health – “the state of being sound or whole in body, mind, or soul” and “freedom from pain or sickness” – and public health – “the health of the community at large.”

Ammonia pollution threatens public health in numerous ways encompassed by these broad definitions. Threats to public health from ambient ammonia include increased risk of respiratory symptoms, eye and nose irritation, and other physical discomfort, as well as more severe health effects. Ammonia also contributes to the health effects of the mixture of gases in CAFO air emissions, which studies have linked to respiratory symptoms as well as headaches, nausea, and increased incidence of infant mortality. If certain communities face a disproportionate and substantial risk of adverse health effects from airborne ammonia, EPA may – and should – find that ammonia warrants regulation as a criteria pollutant. Extensive research conducted on both human and animal subjects over several decades establishes that ammonia emissions endanger human health. Indeed, several federal agencies, including EPA, have recognized this threat by establishing health standards or recommended exposure limits to protect workers and others exposed to airborne ammonia. CAFO emissions research further shows that airborne ammonia levels in some communities currently exceed relevant health benchmarks, demonstrating that ammonia is reasonably anticipated to endanger public health.

⁷ See discussion *infra* Section V.B.1.iii.e.

⁸ *Whitman v. American Trucking Ass’n*, 531 US 457, 466 (2001).

⁹ World Health Organization (1948), <http://www.who.int/about/definition/en/print.html>.

i. EPA should regulate ammonia under the CAA because ammonia exposure causes significant adverse health effects

Ammonia's health effects have been thoroughly documented by the ATSDR, part of the Department of Health and Human Services, as well as the National Academy of Sciences, universities, and other federal agencies. ATSDR assessed "all relevant [ammonia] toxicologic testing and information that has been peer-reviewed" in drafting its Toxicological Profile for Ammonia.¹⁰ EPA employs a similarly thorough review of ammonia health research, the National Academy of Sciences' Acute Exposure Guideline Levels (AEGL) report for ammonia.¹¹ The National Advisory Committee established to draft this report was tasked to "identify, review, and interpret relevant toxicologic and other scientific data" and establish acute exposure guidelines for ammonia and other "high-priority, acutely toxic chemicals."¹² Two Iowa universities have also compiled significant published research on the human health effects of ammonia gas exposure, which they reported in the 2002 Iowa CAFO Air Quality Study.¹³ These three peer-reviewed documents compile and evaluate decades of accidental ammonia exposure case studies as well as human and animal irritation, exposure, and lethality studies.¹⁴

Depending on the concentration, duration of exposure, and sensitivity of the individual exposed, ammonia exposure causes a range of effects including odor detection, nasal, throat, and eye irritation, burns, scarring, and even death. The AEGL report for ammonia summarizes existing acute exposure research in the following chart.¹⁵

¹⁰ ATSDR, *supra* note 6.

¹¹ Acute Exposure Guideline Levels for Selected Airborne Chemicals, Vol. 6, Committee on Acute Exposure Guideline Levels, Committee on Toxicology, Nat'l Research Council of the National Academies of Sciences, available at http://www.epa.gov/oppt/aegl/pubs/ammonia_final_volume6_2007.pdf [hereinafter Ammonia AEGL Report].

¹² Ammonia AEGL Report at 4.

¹³ IOWA STATE UNIV. & UNIV. OF IOWA STUDY GROUP, IOWA CONCENTRATED ANIMAL FEEDING OPERATIONS AIR QUALITY STUDY (2002) at 123 [hereinafter Iowa Study], available at <http://www.public-health.uiowa.edu/ehsrc/CAFOstudy.htm>. See also discussion of Iowa Study *infra* Section V.B.1.ii.d.

¹⁴ ATSDR at 102; Ammonia AEGL Report at 59; Iowa Study at 123-24.

¹⁵ Excerpted from Ammonia AEGL Report, Table 2-5, at 77-78.

SUMMARY OF NONDISABLING AND REVERSIBLE EFFECTS OF INHALED AMMONIA IN HUMANS		
Concentration	Duration of Exposure	Effect
5 ppm	3 hours, with rest and exercise for 1.5 hours each	Subjective rating of eye discomfort and smell, headache, dizziness, and “feeling of intoxication” significantly greater than of controls; sensory adaptation to odor; no exposure-related change in pulmonary function, increase in nasal cells, no increase in exhaled NO, and no alteration in bronchial response to methacholine.
25 ppm	3 hours, with rest and exercise for 1.5 hours each	Subjective rating of eye, upper respiratory, and throat irritation, smell, headache, dizziness, and "feeling of intoxication" significantly greater than of controls; no sensory. Adaptation to odor; no exposure-related change in pulmonary function, increase in nasal cells, no increase in inhaled NO, and no alteration in bronchial response to methacholine.
30 ppm	10 minutes	Odor was moderately intense to highly penetration; irritation was faint or not detectable.
32 ppm	5 minutes	Nasal Dryness.
50 ppm	5 minutes	Nasal Dryness.
50 ppm	10 minutes	Highly penetrating odor; moderate irritation.
50 ppm	30 minutes	Moderately intense odor; moderate irritation to eyes and nose; mild irritation to throat and chest; slight urge to cough; slight general discomfort.
50 ppm	1 hour	Highly intense odor; moderate irritation to eyes, nose, throat, and chest; mild urge to cough; slight general discomfort.
50 ppm	2 hours	Offensive odor; moderate irritation to eyes, nose, throat, and chest, mild urge to cough; mild general discomfort.
72 ppm	5 minutes	Nasal, eye, and throat irritation.
80 ppm	30 minutes	Highly intense odor; highly intense eye and nose irritation; moderate throat and chest irritation; mild urge to cough; moderate general discomfort.
80 ppm	1 hour	Highly intense odor; moderate eye, nose, throat, and chest irritation; mild urge to cough; moderate general discomfort.

80 ppm	2 hours	Highly intense odor; highly intense eye, nose, throat, and chest irritation; highly intense urge to cough; and moderate general discomfort.
100 ppm	5-30 seconds	Significant increase in nasal airway resistance, but atopic subjects, including asthmatics, responded similarly to the nonatopic subjects.
100 ppm	2-6 hours/day, 5 weeks	No adverse effects on respiratory function and no increase in frequency of eye, nose, or throat irritation.
110 ppm	30 minutes	Highly intense odor, highly intense eye, nose throat, and chest irritation, mild urge to cough; moderate general discomfort.
110 ppm	1 hour	Highly intense odor; highly intense eye, nose, throat, and chest irritation; moderate urge to cough, moderate general discomfort
110 ppm	2 hours	Highly intense odor; highly intense eye and nose irritation; urge to cough; general discomfort
140 ppm	30 minutes	Highly intense odor; unbearable eye, nose, throat, and chest irritation; mild urge to cough; moderate general discomfort.
140 ppm	1 hour	Highly intense odor; unbearable eye, nose, throat, and chest irritation; moderate urge to cough; moderate general discomfort.
140 ppm	2 hours	Highly intense odor; unbearable eye and nose irritation; highly intense throat and chest irritation; highly intense urge to cough; unbearable general discomfort
143 ppm	5 minutes	Nose, eye, throat, and chest irritation; lacrimation.
500 ppm	15-30 minutes	Nose and throat irritation; nasal dryness and stuffiness; excess lacrimation; hyperventilation; unbearable.
570 ppm	Single Breath	Threshold for reflex glottis closure, 21 to 30-year-old subjects.
1000 ppm	Single Breath	Threshold for reflex glottis closure, 60-year-old subjects.
1000 ppm	NR	Immediate urge to cough.
1790 ppm	Single Breath	Threshold for reflex glottis closure, 86 to 90-year-old subjects.

Humans detect ammonia odor at concentrations ranging from 5 to 53 parts per million (ppm), and the odor can become “highly penetrating” at 50 ppm after 10 minutes of exposure.¹⁶ One third of the volunteers in one human exposure study experienced irritation after just 10 minutes of exposure to 30 ppm ammonia.¹⁷ The same study showed that eye, nose, throat, and chest irritation become moderate after a 30-minute exposure to 50 ppm and can become “highly intense” after a 30-minute exposure to 80 ppm.¹⁸ At concentrations of 50 ppm, ammonia exposure can lead to throat irritation, mucous production, and cough.¹⁹ At heightened concentrations, ammonia’s effects exceed odor and irritation, and cause actual damage to the respiratory system. This damage may include tracheal and nasopharyngeal burns, and bronchiolar/alveolar swelling.²⁰

Non-fatal effects of acute exposures to high concentrations of ammonia can be long-lasting, and even permanent. One case study considered in ATSDR’s Toxicological Profile monitored the health effects on three men who had been acutely exposed to ammonia gas; the men subsequently reported several symptoms, including burning of the skin, eyes, and throat.²¹ The men also showed signs of stressed airways as evidenced by wheezing and cough. More than two years later, the researchers re-evaluated the men and found continuing symptoms of restrictive lung disease.²² Another case study considered by ATSDR followed a man who, 12 years after exposure to ammonia gas, still suffered from recurrent bronchial infections as well as cough and exertional dyspnea, or shortness of breath while exercising.²³

The Toxicological Profile also documents accidents involving exposure to ammonia that resulted in neurological impacts such as blurred vision, muscle weakness, decreased deep tendon reflexes, and loss of consciousness.²⁴ Due to ammonia’s solubility in water, ocular effects such as inflammation of the eyes and swelling of the eye-lids can occur with exposure to airborne ammonia.²⁵ Ammonia’s solubility also allows it to quickly absorb into the upper airways, where it can damage the epithelial cells.²⁶

In addition, ammonia inhalation can cause fatal burns and infections.²⁷ According to ATSDR, ammonia becomes acutely lethal at concentrations of 5,000-10,000 ppm.²⁸ These levels

¹⁶ Ammonia AEGL Report at 59-60.

¹⁷ *Id.* at 60.

¹⁸ *Id.*

¹⁹ *Id.* See also Iowa Study at 123.

²⁰ ATSDR at 16.

²¹ *Id.* at 48.

²² *Id.*

²³ *Id.*

²⁴ *Id.* at 55.

²⁵ *Id.* at 73.

²⁶ Iowa Study at 123.

²⁷ ATSDR at 25.

²⁸ *Id.*

of exposure often result in chemical burns and swelling of the skin, eyes, and respiratory tract.²⁹ At such high levels, studies have found that the ammonia actually scorches those exposed from the inside out, causing extensive internal damage such as swelling and congestion of the lungs, the stripping off of the epithelial lining of the bronchial wall, and ammonia burns across the upper body, face, and mouth.³⁰

Ammonia's health impacts persist even as it undergoes chemical transformations in the ambient air. Once in the air ammonia reacts to form ammonium aerosols;³¹ both ammonia and these aerosol particles can have devastating effects on cardiovascular and hematological systems. Various non-human studies show that exposure to high concentrations of these compounds can cause high blood pressure, elevated pulse, bradycardia,³² and even cardiac arrest.³³

Specific health effects of acute ammonia exposure incidents depend on several factors, but these ammonia inhalation and exposure studies and literature reviews together document a scientifically accepted correlation between exposure to airborne ammonia and adverse respiratory and other health effects. These studies also consistently report odor, irritation, cough, and other respiratory symptoms for some individuals exposed to ammonia concentrations of approximately 30 ppm even over short periods of time.

Research further indicates that which symptoms a person experiences and which parts of the respiratory tract are affected depend not only on the concentration of ammonia, but also on whether exposure is acute or chronic. Acute exposures to low levels of ammonia affect the upper respiratory tract, whereas exposure to higher concentrations over longer periods of time affect both the upper and lower respiratory tracts and the alveolar capillaries in the lungs.³⁴ At sufficiently high concentrations, ammonia will bypass the upper airways and directly affect the lungs, causing inflammation of the lower lungs and pulmonary edema, or swelling.³⁵

Although less research exists documenting the health effects of chronic ammonia exposures than of acute exposures, ATSDR based its long-term exposure recommendation on a 12-year case study of occupational exposure, from which the agency derived a no observable adverse effect level (NOAEL) of 9.2 ppm.³⁶ This petition will discuss additional studies of health and welfare effects from long-term ammonia exposure near CAFOs.

In short, ammonia released into the air causes both acute health effects and chronic diseases. However, though ammonia may be reasonably anticipated to endanger public health, EPA currently does not regulate airborne ammonia to protect the health of the general public.

²⁹ *Id.*

³⁰ *Id.*

³¹ *Id.* at 34.

³² Slow heart beat; *see* Mayo Clinic, Bradycardia at <http://www.mayoclinic.com/health/bradycardia/ds00947>.

³³ ATSDR at 52.

³⁴ *Id.*

³⁵ Iowa Study at 123.

³⁶ *Id.* at 40.

The only enforceable ammonia standards currently in effect apply exclusively to workers; but as this petition will establish, non-workers near CAFOs and other ammonia sources also require protection from unsafe ambient levels of ammonia. The NAAQS program provides the best mechanism for this protection.

ii. Ammonia is widely recognized as a health threat

Based on ammonia's well-documented and life-threatening health effects, EPA, ATSDR, the Occupational Safety and Health Administration (OSHA), and the National Institute for Occupational Safety and Health (NIOSH) have taken steps to protect workers from dangerous exposures to ammonia and inform the public of the potential risks of exposure. Moreover, groups of experts have considered the health effects of ammonia from CAFOs in particular, and have recommended that EPA regulate ammonia under the CAA based on existing research. This section introduces several relevant health benchmarks, and discusses the merits and limitations of each with regard to assessing the health risk of ambient ammonia. It then discusses the Iowa Study of CAFO emissions and the Pew Commission report on industrial livestock production and their recommendations to protect communities from the health effects of ambient ammonia. This petition will analyze several studies of ammonia emissions from CAFOs, using these various existing and proposed health thresholds as indicators for the risk posed by current ammonia levels at the CAFO vent and in the ambient air.

a. Acute Exposures: EPA's Acute Exposure Guideline Levels

EPA has already adopted both short- and long-term ammonia health guidelines. The first is a system of short-term pollution exposure limits, known as Acute Exposure Guideline Levels (AEGLs), established to guide response actions when people experience a rare – even “once-in-a-lifetime” – short-term, accidental exposure to a toxic chemical.³⁷ The National Advisory Committee reviewed relevant studies and data, then used these studies to establish threshold exposure limits “below which adverse health effects are not likely to occur.”³⁸

EPA divides the AEGLs into three levels: AEGL-1, the concentration above which the public, including susceptible individuals, could experience irritation or discomfort but no lasting effects; AEGL-2, the concentration above which the general public, including susceptible individuals, could experience permanent, serious adverse health effects and an inability to escape from the chemical threat; and AEGL-3, the concentration above which the general public, including susceptible individuals, could experience life-threatening adverse health effects or death.³⁹ EPA established several AEGL concentrations for each level, correlated with different exposure durations. The AEGL-1 for each of several acute-duration exposure times is 30 ppm,

³⁷ EPA, Acute Exposure Guideline Level Program, <http://www.epa.gov/oppt/aegl/index.htm> (last visited Mar. 18, 2011).

³⁸ Ammonia AEGL Report at 4.

³⁹ *Id.* at 4-5.

indicating that after as few as ten minutes, individuals may experience temporary, but adverse, health effects from breathing 30 ppm ammonia.⁴⁰ The following chart shows EPA’s AEGLs for ammonia.⁴¹

Ammonia 7664-41-7 (Final)					
ppm					
	10 min	30 min	60 min	4 hr	8 hr
AEGL 1	30	30	30	30	30
AEGL 2	220	220	160	110	110
AEGL 3	2,700	1,600	1,100	550	390

The AEGLs provide one of the most comprehensive and scientifically rigorous reviews of existing human and animal research on the effects of ammonia exposure. Moreover, these guidelines consider the health effects on high-risk populations, rather than considering only effects on worker health as some other agency standards do. The AEGLs also demonstrate that EPA already recognizes ammonia’s short-term health effects, even at moderate concentrations. Consequently, these guidelines provide a strong foundation from which EPA can establish short-term NAAQS that will protect public health and welfare from short-term elevations in ambient ammonia levels from sources such as CAFOs.

Although the AEGLs provide EPA with a comprehensive review of scientific research with which to regulate, ammonia NAAQS must be more protective than the AEGLs. These levels are set to protect the public from a *once-in-a-lifetime* exposure to ammonia, while many rural citizens breathe elevated CAFO ammonia emissions for varying time periods on a frequent basis for years, or even decades. Thus, while the AEGLs provide a useful starting point for CAA regulation, they do not provide adequate ambient air quality standards.

b. Ambient Exposures: EPA’s Reference Concentration and ATSDR’s Minimal Risk Levels

EPA has also considered and assessed the chronic effects of ammonia inhalation, and established a Reference Concentration (RfC) of 0.14 ppm to indicate a safe level of ammonia to breathe over the long term. EPA derived the RfC from the results of a long-term worker exposure study, which it then adjusted with uncertainty factors to better protect sensitive individuals and account for the lack of a robust data set.⁴² This chronic exposure RfC provides a useful starting point for EPA to use in establishing a one-year or other long-term ambient standard that will protect public health from continuous low-level ammonia emissions.

⁴⁰ EPA, Acute Exposure Guideline Levels Ammonia Results, <http://www.epa.gov/oppt/aegl/pubs/results88.htm> (last visited Mar. 18, 2011).

⁴¹ *Id.*

⁴² ATSDR at 163.

As discussed above, ATSDR has also reviewed existing research on the effects of ammonia exposure on both humans and animals and has established health thresholds called Minimal Risk Levels (MRLs) for both acute and chronic inhalation exposure to ammonia.⁴³ Much like EPA's RfC, in determining MRLs for different substances, ATSDR considered the most susceptible individual and estimated "the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse noncancer health effects over a specified duration of exposure."⁴⁴ Thus, ATSDR established the MRLs to identify the level above which daily exposure to airborne ammonia, in the absence of other pollutants, poses a health risk.

Based on its review of all available ammonia exposure research, ATSDR set its acute MRL for ammonia at 1.7 ppm for inhalation exposure of 14 days or fewer,⁴⁵ and set the chronic MRL at 0.1 ppm for inhalation exposure of 365 days or more.⁴⁶ Both threshold MRLs provide relevant points of reference when determining whether a specific ambient ammonia concentration could create a public health hazard. As this petition will discuss, studies provide evidence that citizens may be exposed to ammonia levels that exceed the MRLs in areas near even a single large CAFO. Moreover, ATSDR has observed respiratory health impacts from a single livestock facility work shift exposure to 7.9 ppm ammonia, but to isolate the effects of ammonia ATSDR specifically excluded this research when establishing the MRLs.⁴⁷ EPA should instead account for the increased health effects from mixed-pollutant exposures when considering safe ambient ammonia levels.

Some of the studies referenced in this petition, such as the Iowa Study discussed below, use the ATSDR's old chronic MRL of 0.3 ppm as the relevant ambient health threshold. As a result they may not conclude that observed ambient ammonia levels above 0.1 ppm pose a health threat. However, in 2004 ATSDR acknowledged that the study on which it had based the prior chronic MRL did not adequately represent all vulnerable populations and could not account for the lack of developmental and reproductive studies. To take this data gap into account, ATSDR used a modifying factor of three and adopted the current 0.1 ppm chronic MRL.⁴⁸ Thus, EPA should re-examine research conclusions based on the under-protective past MRL, with the new MRL in mind.

Between its own and ATSDR's established health thresholds, EPA already has much of the research necessary to establish protective NAAQS for acute, intermediate, and long-term ammonia exposure. However, research focused on CAFO emissions – the source of the majority of ammonia emissions in the U.S, but also a source of hydrogen sulfide, particulates, and hundreds of volatile organic compounds – indicates that adequately protective standards must

⁴³ ATSDR at 18-20.

⁴⁴ ATSDR, Minimal Risk Levels (MRLs) for Hazardous Substances, <http://www.atsdr.cdc.gov/mrls/index.html> (last visited Mar. 18, 2011).

⁴⁵ *Id.*

⁴⁶ *Id.* at 19.

⁴⁷ *Id.* at 18.

⁴⁸ *Id.* at 20.

also account for the additive or synergistic adverse health effects of multiple-pollutant exposures. EPA should consider multiple-pollutant effects when deciding whether and how to regulate ammonia under the CAA.

c. Worker Exposures: NIOSH's Recommended Exposure Limits and OSHA's Permissible Exposure Limit

The NIOSH, part of the Centers for Disease Control and Prevention, has established recommended exposure limits (RELs) for workers breathing ammonia pollution in the workplace. Similarly, OSHA has established a health standard for ammonia in the workplace. NIOSH recommends that employers should not expose workers to more than 25 ppm of ammonia averaged over a ten-hour period or 35 ppm averaged over a 15-minute period.⁴⁹ OSHA permissible exposure limits (PELs) are similar to NIOSH recommendations in that they are meant to protect workers. However, in the case of ammonia OSHA adopted a less stringent benchmark; its enforceable ammonia standard limits worker exposure to a maximum ammonia concentration of 50 ppm, averaged over an 8-hour time period.

NIOSH and OSHA based these exposure levels, unchanged since 1974, on a NIOSH literature review that included both human and animal ammonia exposure studies that were primarily conducted between the 1940s and mid-1960s.⁵⁰ This criteria document noted that at the time of publication, few or no studies on agricultural ammonia exposure existed.⁵¹ When compared to ATSDR's and the National Academy of Sciences' findings of health effects at low exposure levels, it becomes clear that NIOSH did not seek to avoid all adverse health impacts or ammonia irritation when recommending occupational exposure standards. Rather, the report sought to identify "exposure levels at which no employee will suffer impaired health or functional capacities or diminished life expectancy as a result of his work experience."⁵² OSHA is not required to provide workers protection equal to that EPA must provide the public through its CAA authority.

The agencies recognized in 1989 that the OSHA PEL for ammonia did not adequately protect worker health and sought to adopt a more stringent PEL. The amended standard would have set a 15-minute short-term exposure level of 35 ppm through a "generic" rulemaking that covered more than 400 hazardous chemicals. However, the 11th Circuit vacated this rule on procedural grounds unrelated to the need for a more protective ammonia standard, holding that OSHA had failed to adequately support and explain each new standard in its record.⁵³ OSHA has not acted to strengthen the ammonia PEL since its rule was vacated. Thus, even OSHA has

⁴⁹ NIOSH, Pocket Guide to Chemical Hazards, <http://www.cdc.gov/niosh/npg/npgd0028.html> (last visited Mar. 18, 2011).

⁵⁰ *Criteria for a Recommended Standard...Occupational Exposure to Ammonia*, HEW Publication No. (NIOSH) 74-136 (1974), available at <http://www.cdc.gov/niosh/74-136.html> (last visited Mar. 18, 2011).

⁵¹ *Id.* at 60-62.

⁵² *Id.* at 22.

⁵³ See *AFL-CIO v. OSHA*, 965 F.2d 962 (11th Cir., 1992).

recognized that ammonia creates a greater threat to worker health and safety than its current PEL reflects.

Though some of these health benchmarks are under-protective and were never intended to protect the general population from ammonia exposure, and none take multiple pollutant exposures into account,⁵⁴ each can help EPA interpret existing data on ammonia air emissions from stationary sources such as CAFOs and establish safe ambient standards for airborne ammonia. Because ATSDR and EPA's health thresholds address health threats to the general public from both acute and chronic ammonia exposure, they serve best to analyze monitoring of ambient air near residences and public places. Conversely, because the NIOSH and OSHA exposure levels address health threats over shorter periods of time and with only workers in mind, they can provide a frame of reference for monitoring data collected at the source, such as CAFO vents, but have little value in assessing the public health threat posed by ambient ammonia.

d. Iowa's Joint University CAFO Air Quality Study

At the request of then-Iowa Governor and current U.S. Secretary of Agriculture Tom Vilsack, Iowa State University and the University of Iowa completed a significant joint report (the Iowa Study) on air emissions from CAFOs in 2002.⁵⁵ The Iowa Study reviewed and analyzed peer-reviewed studies on various aspects of these emissions, including the volume and nature of CAFO air emissions, the toxicology of pollutants released from CAFOs, and the community health and social impacts of CAFO emissions. The state tasked the study group with answering specific questions about CAFO air emissions; among them, the study set out to answer: “[b]ased on an analysis of peer-reviewed, duplicated, legitimate, and published scientific research, what would you recommend as Iowa or National consensus standards for any proposed substances to be regulated as emissions from CFOs?”⁵⁶

The Study's authors answered this question with a significant recommendation; based on their review of credible CAFO emissions research, they concluded that EPA should regulate certain substances released from CAFOs – namely ammonia, hydrogen sulfide, and odor – under the CAA NAAQS program.⁵⁷ Based on this emissions research, as well as state ammonia standards, ATSDR and EPA recommendations, and research on the additive or synergistic effects of multiple pollutants in CAFO emissions, the Study recommends that protective

⁵⁴ Regardless whether EPA has considered additive effects of multiple-pollutant exposures in establishing NAAQS for criteria pollutants to date, the CAA requires EPA to list criteria pollutants if they “cause or contribute to” pollution that may endanger public health. CAA § 108(a)(1)(A). Thus EPA should consider the health effect of CAFO emissions as a whole when determining a safe level of ambient ammonia exposure.

⁵⁵ IOWA STATE UNIV. & UNIV. OF IOWA STUDY GROUP, IOWA CONCENTRATED ANIMAL FEEDING OPERATIONS AIR QUALITY STUDY (2002) at 123 [hereinafter Iowa Study], available at <http://www.public-health.uiowa.edu/ehsrc/CAFOstudy.htm> (last visited Mar. 18, 2011).

⁵⁶ Iowa Study at 8. The study uses the Iowa regulatory term “CFO” interchangeably with CAFO. *Id.* at 5.

⁵⁷ *Id.* at 8.

ammonia one-hour averages should not exceed 500 ppb (0.5 ppm) at the CAFO property line or 150 ppb (0.15 ppm) in residential and public use areas.⁵⁸

While this ambient level very nearly matches EPA's RfC for ammonia, the Study recommends 0.15 ppm as a one-hour average limit, rather than a long-term limit, due to the complex effects of breathing numerous pollutants simultaneously. Thus, as a result of studying CAFO emissions specifically, and not simply examining ammonia gas in isolation, the Iowa Study emphasized the most typical route for ambient ammonia exposure and its researchers proposed a far more protective standard than any federal agency to date. EPA should consider the Iowa Study's peer-reviewed recommendations and findings when reviewing this petition.

e. Pew Commission Report on Industrial Farm Animal Production

In 2008, the Pew Commission on Industrial Farm Animal Production (PCIFAP), an independent project of Johns Hopkins Bloomberg School of Public Health and the Pew Charitable Trusts, released a similarly comprehensive report on the impacts of industrial livestock production. This report – “Putting Meat on the Table: Industrial Farm Animal Production in America”⁵⁹ (the Pew Commission Report) – compiled the published literature on a wide range of CAFO impacts, including air emissions and their effects on public health.

Among its recommendations, the Pew Commission Report concluded that “EPA should develop a standardized approach for regulating air pollution” from CAFOs under the CAA.⁶⁰ The Report also noted the complicated effects of mixed air pollutants found in CAFO emissions and the importance of considering these mixed exposures.⁶¹ The Pew Commission Report analyzed the most current and comprehensive CAFO emissions and health research from across the globe, and EPA should consider its findings and recommendations when reviewing this petition.

The Pew and Iowa reports fill large information gaps left by federal agencies that have assessed ammonia's health impacts, both by focusing on ammonia's primary source – CAFOs – and by considering ammonia's effects when mixed with other hazardous pollutants. Moreover, both reports conclude that EPA should use the CAA to address the public health threats posed by ammonia and other CAFO emissions.

Taken together these standards, guidelines, and expert recommendations demonstrate that ammonia is a recognized toxic air pollutant that requires CAA regulation to protect the public

⁵⁸ *Id.* at 176.

⁵⁹ PEW COMMISSION ON INDUSTRIAL FARM ANIMAL PRODUCTION, PUTTING MEAT ON THE TABLE: INDUSTRIAL FARM ANIMAL PRODUCTION IN AMERICA (2008) [hereinafter Pew Commission Report], *available at* <http://www.ncifap.org/> (last visited Mar. 18, 2011).

⁶⁰ *Id.* at 75.

⁶¹ *Id.* at 69.

health. Even at low levels, acute and chronic exposures to ammonia gas pose significant health threats, and EPA should use this collective evidence base to establish protective NAAQS.

iii. EPA should regulate ammonia under the CAA because unsafe ambient levels of ammonia currently threaten public health

EPA should regulate ammonia under the Clean Air Act because studies show that CAFOs emit ammonia into the air at levels exceeding EPA and ATSDR benchmarks in the ambient air and exceeding NIOSH and OSHA benchmarks at the source, thereby threatening public health in certain areas. Though a limited number of peer-reviewed emissions studies exist, those available found dangerous ammonia concentrations that require regulation to protect nearby residents.

a. CAFO emissions generate ambient ammonia concentrations that exceed EPA's RfC and ATSDR's MRLs

EPA should regulate ambient ammonia because CAFOs emissions give rise to ambient ammonia concentrations that exceed EPA's chronic exposure RfC and ATSDR's acute and chronic MRLs, and that therefore may reasonably be anticipated to endanger public health. The agencies derived these benchmarks to identify the threshold level below which long-term exposure is thought to be safe, but above which uncertainty remains. Thus, when ambient ammonia levels exceed these thresholds, those exposed face a possible risk of adverse health effects. This threat can most appropriately be addressed through the NAAQS program.

To date, the most significant studies of ambient ammonia levels from CAFO emissions showed that some CAFOs do in fact cause unsafe ambient ammonia levels, even at significant distances from the facility. While researchers have conducted numerous studies of the health symptoms experienced due to CAFO emissions, and EPA has studied ammonia levels at the CAFO vent, very few studies have actually measured ammonia levels in the ambient air. Two significant studies discussed in this petition are ATSDR's study of a Missouri hog CAFO and the University of Georgia's study of a Georgia broiler CAFO.

Missouri Hog CAFO Study

In August of 2003, the ATSDR and the Missouri Department of Health and Senior Services (DHSS) released a CAFO ammonia emissions Health Consultation, reporting the results of an ammonia Exposure Investigation (EI) conducted by ATSDR and DHSS in a community near a large swine CAFO.⁶² The agencies conducted the study in response to complaints by

⁶² U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, Division of Health Assessment and Consultation, prepared by the Missouri Department of Health and Senior Services Section for Environmental Public Health, Health Consultation: Final Report on Exposure Investigation Findings, Valley View Concentrated Animal Feeding Operations (Aliases: Concentrated Animal Feeding Operations and Confined Animal Feeding Operations), Green Castle, Sullivan County, Missouri (2003) [hereinafter Missouri Health Consultation].

residents that the air emissions from the CAFO were adversely affecting respiratory health and quality of life.⁶³

The investigation focused on ammonia emissions downwind from the Premium Standard Farms Valley View swine CAFO, which at the time had a permit to house 123,648 hogs.⁶⁴ Investigators sampled ammonia levels at 6 houses, which they selected based on the proximity of the house to the CAFO, the location of the house downwind from the CAFO, and the willingness of the homeowner to participate in the investigation.⁶⁵ The investigators monitored one outdoor and one indoor location at each house.⁶⁶ They placed sampling equipment at breathing zone height and monitored each location continuously for no less than 3 consecutive days during the 12 day study.⁶⁷ EPA and the Missouri Department of Natural Resources (MDNR) took concurrent samples at the same outside locations, as well as 12-hour time-weighted averages inside the homes, to compare with ATSDR's results.⁶⁸ The study measured ammonia concentration in ppm and reported results as 24-hour maximum discrete measurements (each monitor's highest measurement each day) and 24-hour averages.⁶⁹ ATSDR also surveyed 77 homes within a one-mile radius, and 39 homes between one and two miles from the CAFO, to evaluate residents' perceptions of odors and health symptoms.⁷⁰

In the Health Consultation, ATSDR compared monitoring results with its former acute and chronic MRLs. This discussion will instead use the current MRLs, which ATSDR revised in 2004, as more pertinent benchmarks for possible health impacts.⁷¹ Monitoring from all six of the studied houses resulted in ammonia levels of concern. 41 out of 46 of the study's maximum discrete measurements, which were reported daily at each house both inside and outside, exceeded the chronic MRL of 0.1 ppm.⁷² Daily maximum samples from inside houses 1032 and 1110 also exceeded the acute MRL of 1.7 ppm. Monitors in house 1032 recorded maximum discrete measurements of approximately 4.3 ppm, 2.0 ppm, and 2.0 ppm for Day 1, Day 2, and Day 3 respectively.⁷³ At 1.9 ppm, the maximum discrete measurement taken inside of house 1110 on Day 1 also exceeded the acute MRL.⁷⁴

The results from the 24-hour averages also give cause for concern. While this study lasted only three days at each home, and ATSDR's chronic MRL sets a health effects benchmark for exposure exceeding a year, 24-hour averages most closely indicate the amount of ammonia

⁶³ Missouri Health Consultation at 1.

⁶⁴ *Id.* at 2.

⁶⁵ *Id.* at 3.

⁶⁶ *Id.*

⁶⁷ *Id.*

⁶⁸ *Id.* at 2-3.

⁶⁹ *Id.* at 5-6.

⁷⁰ *Id.* at 3.

⁷¹ See discussion *supra* Section V.B.1.ii.b.

⁷² Missouri Health Consultation at 3.

⁷³ *Id.* at 6.

⁷⁴ *Id.*

these residents breathe on a daily basis. Thus, these averages can most meaningfully be compared with the chronic MRL and the RfC. All of the average measurements inside of houses 1028, 1032, and 1110 during the three-day period exceeded the chronic MRL.⁷⁵ In the absence of a longer-term study, all evidence indicates that residents downwind from large CAFOs may suffer health impacts from chronic low-level ammonia exposure.

Three factors in this study indicate that it under-represents the ammonia concentrations and risk faced by this and other rural communities. First, ATSDR acknowledges that the “downwind” homes studied were actually only downwind of the CAFO during approximately 10 percent of the monitoring period, and the Health Consultation also points out that ammonia concentrations were “significantly higher when wind was directed from the site to the monitor.”⁷⁶ Though Valley View houses an enormous number of hogs, these residents experienced direct emissions only a small percent of the time and lived as far as a mile from the site; communities with CAFOs on multiple sides and that have CAFOs very nearby will likely face elevated ammonia concentrations more often. Second, ATSDR states that land application of manure took place during less than half of the monitoring period, and thus “the maximum period of exposure is not believed to have been attained during this EI.”⁷⁷ Third, as EPA pointed out in its comments on the draft consultation, ammonia levels increase as wind speed decreases. The study did not take place during the season with lowest wind speeds, thus residents likely breathe higher ambient concentrations during much of the year.⁷⁸

These limitations on the study, limits on the general applicability of ATSDR’s MRLs, and ATSDR’s use of a less protective and since-replaced chronic MRL in its study, likely contributed to the Health Consultation’s conclusion that no apparent public health hazard existed near the houses at the time of the EI. However, as noted previously, EPA commented on the draft report and came to the *opposite* conclusion. In a memorandum written by EPA’s Stationary Source Enforcement Branch of the Air Enforcement Division to the Director of the Missouri DHSS, EPA weighed in to “better inform the conclusions in the final report.”⁷⁹

EPA’s memo acknowledged the complexity of CAFO air emissions, and contrasted the Valley View study with the 2002 Iowa Study.⁸⁰ EPA further suggested that the Iowa recommendations apply a more comprehensive analysis than the ATSDR MRLs alone because the Iowa Study considered numerous studies in addition to those relied on by ATSDR, including studies of the aggregate effect that mixed exposures can have on public health.⁸¹ Consequently,

⁷⁵ *Id.* at 5.

⁷⁶ *Id.* at 8.

⁷⁷ *Id.*

⁷⁸ EPA, Office of Enforcement and Compliance Assurance, Memorandum from Mario Jorquera to Scott Clardy, Comments on the Valley View Health Consultation, (Dec. 2002) [Hereinafter EPA Memo].

⁷⁹ EPA Memo at 1.

⁸⁰ See discussion *supra* Section V.B.1.ii.d.

⁸¹ EPA Memo at 2. Note that this letter’s discussion of the MRLs refers to the MRLs established in the 1990 ATSDR toxicological profile for ammonia, which predated the more protective chronic MRL adopted in 2004.

the memo emphasized the fact that, “during the Valley View field investigation, the [ATSDR] monitors recorded 60 occurrences of one-hour ammonia concentrations ranging from 153 ppb to 875 ppb, well in excess of the Iowa Study’s recommended limit.”⁸² EPA pointed out that house 1032 was exposed to 10 of these high readings over a 20 hour period and that, in fact, every house studied reported elevated exposures.⁸³ As a result, EPA found that “the conclusion could be drawn that a *public health hazard* did exist at the time the Valley View data was acquired”⁸⁴ (emphasis in original).

EPA’s emphasis on the one-hour concentrations measured outside and inside of the studied homes, as well as its adoption of the Iowa Study’s far more protective recommendations, demonstrates that the agency understands ammonia’s short-term, localized, and additive health effects. The results of the Valley View Health Consultation indicate potential health threats from both short-term and long-term exposure to CAFO ammonia emissions.

EPA should consider the results of the Missouri health consultation and draw on the findings in its own memo, which concluded that ambient ammonia emissions from a single Premium Standard Farms hog CAFO may have created a public health hazard for residents as far as a mile away. The fact that the Valley View CAFO exposed neighbors to ammonia concentrations above the ammonia MRLs and above the recommended exposure limit of the Iowa Report weighs heavily in favor of creating ambient standards for this pollutant, particularly in light of EPA’s analysis of multiple pollutant effects, spikes in emissions at certain times of year, the effect of wind directions, and the scientific foundations of the Iowa Report.

Georgia Broiler CAFO Study

In 2009, researchers from the University of Georgia, Athens, released the results of the first study of measured ammonia concentrations in the ambient air near poultry houses.⁸⁵ The researchers compared their data with OSHA’s and EPA’s odor threshold values, as opposed to the health-based MRLs or RfC, which limits the value of the study’s conclusions. However, when compared to the more relevant MRLs, RfC, and the Iowa Study’s recommendations, the ammonia data collected indicate potential adverse health effects near large poultry facilities.

The researchers set out to measure ammonia concentrations at varying distances from one broiler operation, and to determine the effects of wind speed and direction on ambient ammonia levels.⁸⁶ The broiler CAFO studied had four houses, each with approximately 23,500 birds.⁸⁷ Monitors measured ammonia concentrations once per minute at various distances from the

⁸² *Id.* at 2.

⁸³ *Id.*

⁸⁴ *Id.*

⁸⁵ B. D. Fairchild et. al, *Ammonia concentrations downstream of broiler operations*, 18 J. Appl. Poultry Res. 630 (2009), available at <http://japr.fass.org/cgi/content/full/18/3/630> (last visited Mar. 18, 2011).

⁸⁶ *Id.* at 631.

⁸⁷ *Id.* at 631-32.

ventilation fans, from 100 to 500 feet, and reported results as 15-minute averages. Measurements were taken over two monitoring periods: a three-week period with measurements at 100-, 200-, and 300-foot distances; and a one-week period with measurements at 100-, 300-, and 500-foot distances. The latter study period included the farther-away monitoring location to account for increased emissions as the birds grew larger, producing more emissions and necessitating higher ventilation rates that create greater total air flow.⁸⁸

Unsurprisingly, the highest ammonia concentrations were strongly correlated with proximity to the broiler houses as well as with times when the monitors were directly downwind of the ventilation fans. The monitors also recorded elevated concentrations during times of low wind speed.⁸⁹ After averaging 1,135 15-minute averages over the four-week study, the ammonia concentration at 100 feet from the facility was approximately 0.5 ppm for each study period, and the overall average at 300 feet exceeded 0.3 ppm for each study period. The final week of monitoring recorded an overall average concentration of approximately 0.25 ppm at 500 feet.⁹⁰

While the researchers failed to discuss potential health impacts of their findings, instead comparing the data to EPA's odor threshold limit of between 5 and 50 ppm, all of these overall averages exceed the chronic MRL, the RfC, and the Iowa Study's recommended one-hour average limit – some by several times. Moreover, during the study the maximum 15-minute averages exceeded 2 ppm at all but the 500-foot monitor.⁹¹ This study indicates that just one broiler CAFO with fewer than 100,000 birds can cause ambient ammonia levels to exceed chronic and acute health exposure limits, despite variations in wind direction and ventilation practices. As far as the petitioners could determine no published studies to date have measured ambient ammonia concentrations near multiple poultry CAFOs, but multiple CAFOs would increase total ammonia emissions as well as the amount of time that a given residence or public use location would be downwind from emission vents.

The Missouri and Georgia studies both demonstrate that just one CAFO can produce enough ammonia emissions to exceed chronic and acute health thresholds, even without taking the heightened effects of multiple-pollutant exposures into account. Citizens living near one or more large CAFOs require protection from this demonstrated public health threat.

b. The results of EPA's National Air Emissions Monitoring Study show that ammonia emissions may significantly exceed NIOSH and OSHA safety thresholds

⁸⁸ *Id.* at 632-33.

⁸⁹ *Id.* at 635-37.

⁹⁰ *Id.* at 633.

⁹¹ *Id.* at 635.

EPA has recognized the need to study and potentially regulate airborne ammonia from CAFOs, the leading source of U.S. ammonia emissions. From 2007 to 2009 EPA contracted with Purdue University to conduct the National Air Emissions Monitoring Study (NAEMS), which measured emissions of airborne ammonia and other pollutants at 24 CAFO sites in the United States.⁹² EPA is currently reviewing the study results to establish emission estimating methodologies for CAFO air emissions.⁹³ A preliminary assessment of the results from the study, which Purdue presented as a series of 24-hour average values compiled from minute-by-minute monitoring results, shows that most of the monitored CAFOs emit levels of ammonia that exceed OSHA's PEL and both NIOSH RELs at the emission vent on certain days during the study, and that ammonia emissions fluctuate significantly on a daily and seasonal basis.⁹⁴

The NAEMS study measured ammonia emissions at the vent and at inlet points adjacent to confinement buildings, rather than in the ambient air at a distance from the CAFOs, because the study seeks to establish emissions rates for different types of CAFOs and thereby enable estimates of total CAFO emissions. Due to the nature of the NAEMS data, the petitioners compared these ammonia concentrations with NIOSH and OSHA worker health exposure levels, rather than ATSDR's or EPA's exposure recommendations. At-the-vent measures relate most directly to worker health benchmarks, while the ATSDR and EPA health thresholds, intended for the general population, will provide a superior frame of reference for establishing protective NAAQS.

As previously discussed, NIOSH recommends a worker exposure limit of 25 ppm of ammonia averaged over a ten-hour period and 35 ppm averaged over a 15-minute period,⁹⁵ while OSHA limits worker exposure to a maximum average ammonia concentration of 50 ppm over an 8-hour time period. Emissions approaching these benchmarks threaten the health and well-being of CAFO workers and also of nearby residents who breathe lower levels of ambient ammonia, but cannot leave the polluted air behind at the end of the work day.

To meaningfully incorporate data measuring emissions at the source into a consideration of whether likely public health threats exist from ammonia in the ambient air, EPA should consider several factors. First, the general public includes populations significantly more sensitive to ammonia than most workers, and thus even if they were protective of worker health, the NIOSH and OSHA standards would not protect public health even for short-term exposures.

⁹² EPA, Air Emissions Monitoring Study, <http://www.epa.gov/oecaagct/airmonitoringstudy.html> (last visited Mar. 18, 2011); Purdue University, National Air Emissions Monitoring Study Frequently Asked Questions, <https://engineering.purdue.edu/~odor/NAEMS/faqs.htm> (last visited Mar. 18, 2011). EPA will analyze the results of a Tyson monitoring study in Kentucky as a 25th site when reviewing the NAEMS data. See <http://www.epa.gov/airquality/agmonitoring/data.html> (last visited Mar. 18, 2011).

⁹³ See EPA, Agriculture – Air Monitoring, <http://www.epa.gov/airquality/agmonitoring/>.

⁹⁴ See Environmental Integrity Project, *Hazardous Emissions from Factory Farms*, (March 2011), available at http://www.environmentalintegrity.org/03_09_2011.php [hereinafter *Hazardous Emissions from Factory Farms*] (last visited Mar. 18, 2011).

⁹⁵ NIOSH, Pocket Guide to Hazardous Chemicals, <http://www.cdc.gov/niosh/npg/npgd0028.html>.

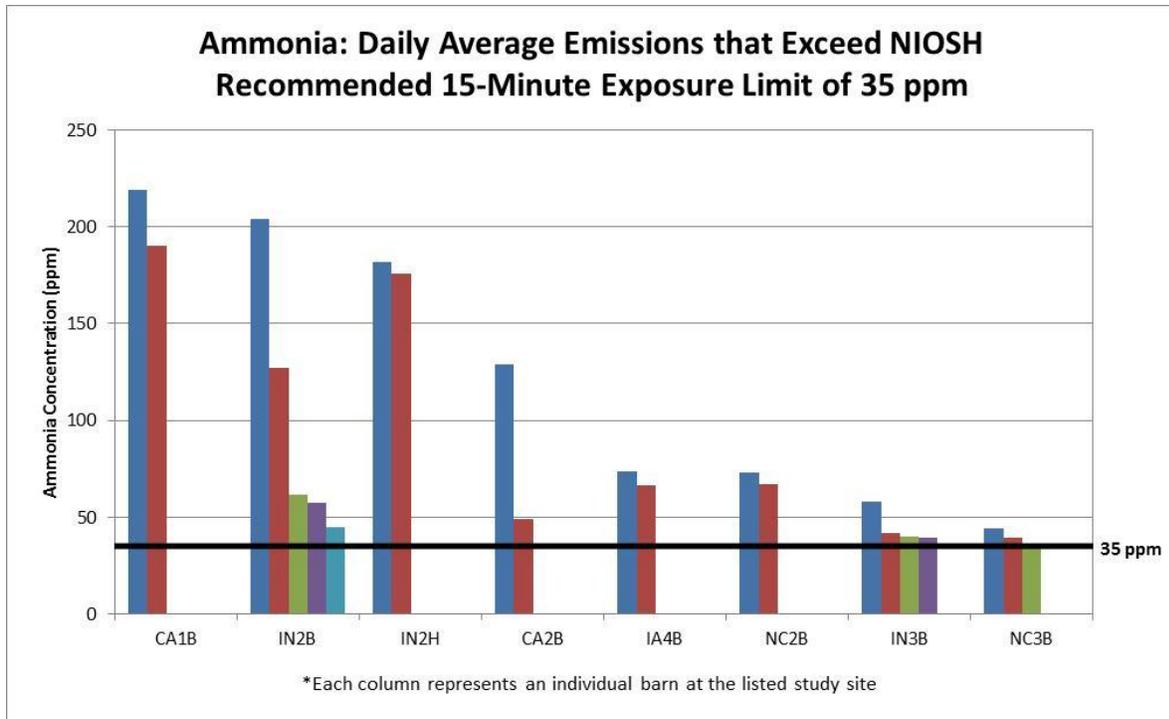
Second, NIOSH and OSHA standards do not consider health effects resulting from continuous intermediate or long-term exposures. Third, the NAEMS data reflect only emissions from a certain part of a CAFO, such as confinement buildings, rather than all emissions sources at or near the site. Finally, many areas contain numerous CAFOs whose emissions mix in the area's ambient air, and consequently one cannot make the assumption that ambient ammonia levels will dissipate to safe levels near the source. Whether emissions that exceed NIOSH recommendations or OSHA standards at the vent will also exceed levels that may cause adverse effects – either alone or in combination with other CAFO emissions – and thus may reasonably be anticipated to endanger public health, will vary on a site-to-site basis.

On March 9, 2011, EIP released a report analyzing the data for the 15 confinement sites in NAEMS,⁹⁶ which included comparisons of monitoring results with the NIOSH 15-minute REL of 35 ppm. The daily averages can also easily be compared to the 10-hour REL of 25 ppm and the OSHA 8-hour PEL of 50 ppm.⁹⁷ Preliminary results from the NAEMS study suggest that CAFO emissions at certain sites commonly exceed both of the NIOSH RELs and even OSHA's significantly under-protective 8-hour standard. In fact, 7 of 15 sites had entire days averaging above the OSHA standard, 9 of 15 sites had entire days averaging above the NIOSH 10-hour standard, and as shown below, 8 of 15 sites had entire days averaging above the NIOSH 15-minute standard.⁹⁸

⁹⁶ Hazardous Emissions from Factory Farms, *supra* note 94. The confinement building monitoring sites reviewed in EIP's report are CA1B, CA2B, CA5B, IA4B, IN2B, IN2H, IN3B, IN5B, NC2B, NC3B, NC4B, NY5B, OK4B, WA5B, and WI5B.

⁹⁷ EIP initially sought to compare averages from the monitoring study to the NIOSH RELs and the OSHA PEL by determining the number of 15-minute, 10-hour, and 8-hour exceedances, respectively. However, due to the unavailability of the raw data from the second year of the study, EIP was unable to compile these averages and instead simply identified 24-hour periods during which emissions exceeded the standards. As a result, EIP was also unable to identify very short-term spikes in emissions that may have taken place.

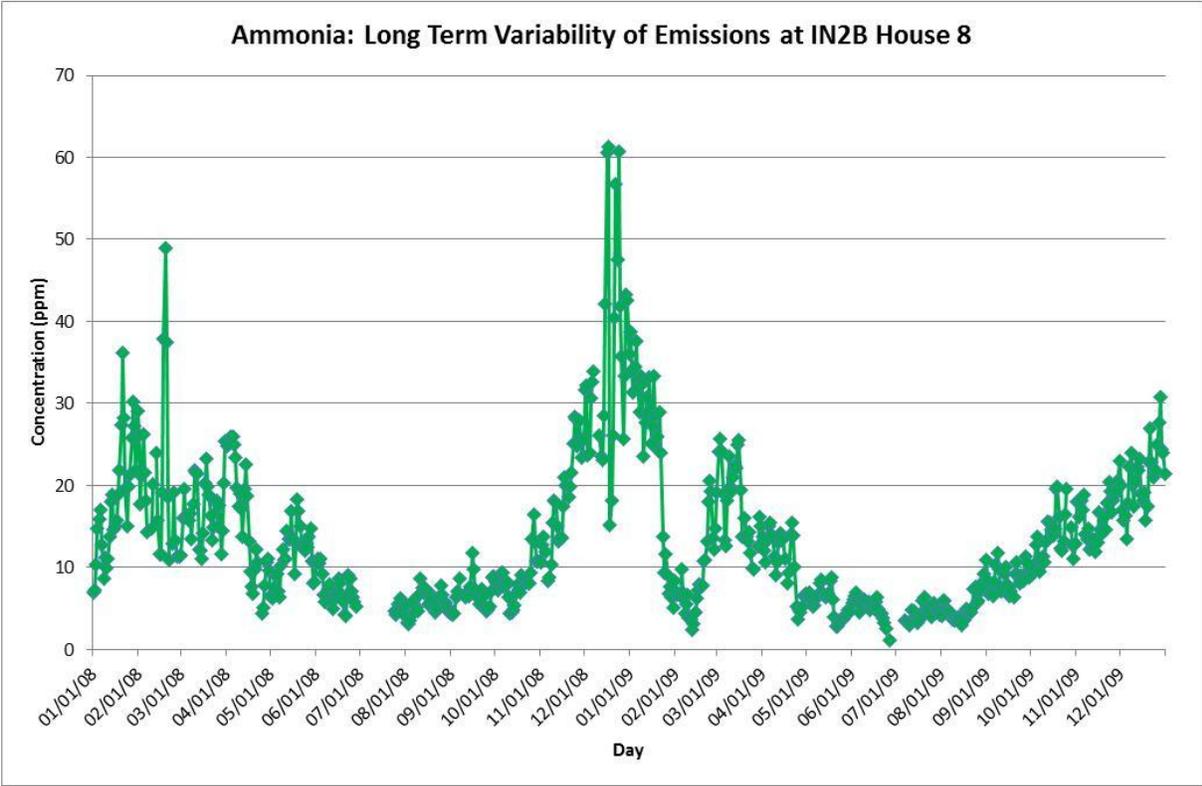
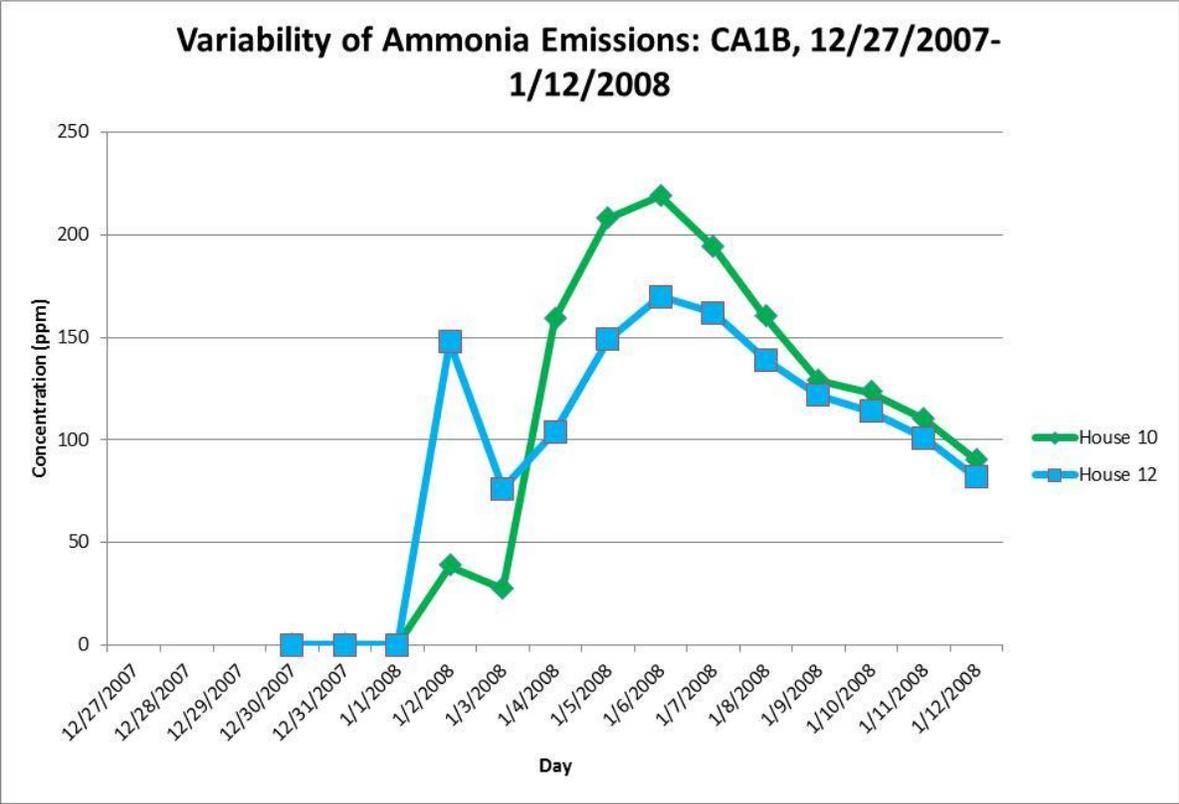
⁹⁸ See Summary Reports at <http://www.epa.gov/airquality/agmonitoring/> and Hazardous Emissions from Factory Farms at 15-16.



In addition to finding numerous exceedances of these time-weighted averages, EIP found that ammonia emissions vary significantly over days and seasons.⁹⁹ The following charts, derived from NAEMS data for a California broiler chicken site and an Indiana layer hen site, show both high average concentrations of ammonia on-site and large fluctuations in emissions.¹⁰⁰

⁹⁹ See Hazardous Emissions from Factory Farms at 13-15.

¹⁰⁰ *Id.* at 15.



This initial assessment suggests that EPA’s representative CAFOs emit ammonia at levels significantly above worker health benchmarks. The petitioners urge EPA to promptly complete its independent review of Purdue’s study and the NAEMS data, and establish emission estimating methodologies that will enable EPA to accurately inventory CAFO ammonia emissions nationwide.

Although these at-the-vent measures cannot be directly translated into ambient ammonia levels, the NAEMS study’s findings still bear on EPA’s consideration of ammonia’s public health impacts. As this petition discusses in the following section, because many regions and communities contain high concentrations of CAFO facilities, EPA cannot assume that at-the-vent measures do not affect ambient ammonia levels. Moreover, because the NAEMS data show that CAFO ammonia emissions are not stable in quantity and rate, but rather spike to high levels for short durations and vary significantly throughout the year, EPA cannot discount at-the-vent measures under the assumption that all emissions will dissipate to safe levels before impacting nearby residents. EPA should consider the NAEMS data when assessing the public health threat of ambient ammonia from CAFOs.

c. Ammonia in CAFO emissions contributes to documented adverse health impacts on nearby residents

Studies of public health in communities near CAFOs indicate that air emissions from these operations, including ammonia emissions, adversely affect respiratory health of residents breathing ambient air near CAFOs. Although these studies examine the health effect of combined air pollutants from livestock operations, rather than attempting to isolate the effects of ammonia emissions, the CAA requires EPA to list as criteria pollutants those pollutants that “*contribute to* air pollution which may reasonably be anticipated to endanger public health” (emphasis added) § 108(a)(1)(A). Ammonia is a known toxin and respiratory irritant emitted by CAFOs in vast quantities, and therefore clearly “contributes to” the air pollution causing known health impacts near these facilities.

The 2002 Iowa Study reviewed research on both occupational and community exposures to CAFO air emissions and their documented health impacts. Though occupational exposures have been more extensively researched, the Study authors found “experimental and epidemiological evidence that very low levels of exposures to ammonia...may result in adverse health effects among healthy volunteers and community residents.”¹⁰¹ Despite the relatively small number of peer-reviewed studies of community health impacts that existed at the time, the Iowa Study concluded that the research base was sufficient to “support a conclusion that CAFO air emissions constitute a public health hazard.”¹⁰²

¹⁰¹ Iowa Study at 138.

¹⁰² *Id.*

One sociological study considered by the Iowa Study authors involved a survey of 18 Iowa residents who lived within 2 miles from a 4,000 head sow confinement operation.¹⁰³ The study compared self-reported answers from the hog CAFO neighbors with those of a control group that did not live near significant livestock production,¹⁰⁴ and separated health impacts into four categories of symptoms commonly experienced by CAFO workers: 1) cough, sputum, shortness of breath, chest tightness, and wheezing; 2) dizziness, weakness, fainting, and nausea; 3) plugged ears and headaches; 4) scratchy throat, runny nose, and burning eyes.¹⁰⁵ The study found an increase in all four groups of symptoms among residents in the hog CAFO community.¹⁰⁶

Another study considered both health effects and quality of life impacts of living near CAFOs. Researchers interviewed 155 residents from three North Carolina communities: one near two industrial cattle facilities, one near a 6,000 head hog CAFO, and one without any CAFOs nearby.¹⁰⁷ The study asked questions about rural health, rather than the livestock operations, to avoid bias. Residents near the hog CAFO reported higher rates of several respiratory and other symptoms compared to the control group, including headaches, coughing, sore throat, burning eyes, diarrhea, and runny nose.¹⁰⁸

New research further supports the Iowa Study's findings. In March 2011, Schinasi, et al. published an epidemiological study correlating air pollution from hog CAFOs in North Carolina with self-reported health effects among community residents.¹⁰⁹ The study examined associations between monitored air pollutants and physical symptoms among 16 communities living within 1.5 miles of hog operations.¹¹⁰ Although monitored pollutants did not include ammonia, participants also reported overall odor levels. The researchers found that "[i]rritation symptoms were elevated in association with odor"¹¹¹ and concluded that "pollutants near hog operations cause acute physical symptoms, particularly upper respiratory symptoms and irritation of the nose and eyes."¹¹²

The Pew Commission report also reviewed research on the public health effects of CAFOs, and similarly found that living in close proximity to CAFOs has documented adverse health effects. In particular, studies have shown respiratory health impacts from CAFO air

¹⁰³ Thu et al., *A Control Study of the Physical and Mental Health of Residents Living Near a Large-Scale Swine Operation*, 3 J. of Agric. Safety and Health (1997).

¹⁰⁴ *Id.*

¹⁰⁵ *Id.*

¹⁰⁶ *Id.* Cluster 4 showed a slight prevalence in the hog community (with the exception of the "other" symptoms in cluster 4, which did not show a difference between the two communities studied).

¹⁰⁷ Steve Wing and Susanne Wolf, *Intensive Livestock Operations, Health and Quality of Life Among Eastern North Carolina Residents*, 108 *Env'tl Health Perspectives* (March 2000).

¹⁰⁸ *Id.* at 237.

¹⁰⁹ Schinasi, et al., *Air Pollution, Lung Function, and Physical Symptoms in Communities Near Concentrated Swine Feeding Operations*, 22 *Epidemiology* 2 (March 2011) [hereinafter Schinasi].

¹¹⁰ *Id.* at 1.

¹¹¹ *Id.* at 5.

¹¹² *Id.* at 7.

emissions; primary respiratory effects included increased incidence of asthma among both children and adults. The Commission identified four “large epidemiological studies” that found “strong and consistent” links between CAFO pollution and asthma,¹¹³ concluding that communities near CAFOs “are subject to air emissions that, although lower in concentration [than worker exposures], may significantly affect certain segments of the population.”¹¹⁴

A 2005 study simulated the health effects of short-term exposure to hog CAFO emissions, by diluting hog CAFO air and exposing 24 healthy adults (12 male, 12 female) for one hour at a time on two separate occasions.¹¹⁵ The researchers exposed a control group of 24 healthy adults to clean air for the same time period. The study measured objective health indicators, such as blood pressure, and participants also self-reported symptoms such as headaches and nausea and completed a Profile of Mood States survey.¹¹⁶ The diluted hog confinement air had an ammonia concentration of 817 ppb (0.817 ppm)¹¹⁷ – well below levels observed in the ambient air near some CAFOs, yet several times the 150 ppb one-hour standard recommended in the Iowa Study. After just an hour of exposure, those exposed to the hog confinement air were four times as likely to report headaches, six times more likely to report eye irritation, and nearly eight times as likely to report nausea than the control group.¹¹⁸

Another recent study compared nation-wide, county-level data on infant mortality rates and causes with geographic shifts in the livestock industry over two decades, in order to assess the impacts of living in proximity to livestock on infant mortality and the probable mechanisms for any impact observed.¹¹⁹ After controlling for numerous variables and potential sources of bias, the author found that “a 100,000 animal unit increase [at the county level] corresponds to 123 more infant deaths per 100,000 births,” with about 80% of these occurring during first 28 days of life.¹²⁰ Given the robustness of the data set, this demonstrates a “statistically significant correlation between livestock and infant death.”¹²¹ Of these mortalities, only respiratory and perinatal causes of death were affected, “suggesting an air pollution mechanism.”¹²² Of the many constituents of livestock air emissions, the study cites ammonia and hydrogen sulfide as

¹¹³ Pew Commission Report at 17.

¹¹⁴ *Id.*

¹¹⁵ Susan S. Schiffman et al., *Symptomatic Effects of Exposure to Diluted Air Sampled from a Swine Confinement Atmosphere on Healthy Human Subjects*, 113 *Env'tl Health Perspectives* 5 (May 2005).

¹¹⁶ *Id.* at 568-70.

¹¹⁷ *Id.* at 568.

¹¹⁸ *Id.* at 573.

¹¹⁹ S. Sneeringer, *Does Animal Feeding Operation Pollution Hurt Public Health? A National Longitudinal Study of Health Externalities Identified by Geographic Shifts in Livestock Production*, 91 *Amer. J. of Agric. Econ.* 1 (Feb. 2009).

¹²⁰ *Id.* at 129.

¹²¹ *Id.*

¹²² *Id.* at 125.

the “main gases in question,” because both have been linked to respiratory infections and distress in infants, perinatal disorders, and spontaneous abortion.¹²³

d. CAFOs emit vast quantities of ammonia and are often concentrated geographically

i. CAFOs emit vast quantities of ammonia

EPA should regulate ambient ammonia because estimated CAFO ammonia emission rates indicate that these facilities release vast quantities of ammonia into the ambient air, creating a heightened health threat to communities near numerous and/or very large CAFOs. CAFOs are leading contributors to the nation’s ammonia inventory; by one EPA estimate livestock account for approximately 80 percent of total emissions.¹²⁴ CAFOs also emit a disproportionately large share of the ammonia in certain states and communities. One striking example is Threemile Canyon dairy farm near Boardman, Oregon, which reported ammonia emissions as high as 15,500 pounds per day in 2005 – more than the nation’s number one manufacturing source of the pollutant.¹²⁵ Two studies – the Tyson Broiler Report and the Purdue NAEMS Layer Site study – measured the emission rates of ammonia released from broiler houses and layer barns, respectively. EIP used these emission rates to roughly estimate poultry CAFO ammonia emissions on a much broader scale, and found that poultry CAFOs in several states release an overwhelming majority of those states’ ammonia emissions.

In May 2007, Iowa State University and the University of Kentucky released the “Tyson Broiler Ammonia Emission Monitoring Project: Final Report.”¹²⁶ The report, which Tyson agreed to participate in pursuant to a settlement with the Sierra Club,¹²⁷ summarized a study in which university researchers measured ammonia emissions from two broiler houses in Western Kentucky with Mobile Air Emissions Monitoring Units (MAEMUs) attached to each house.¹²⁸ Each house had a series of six flocks of broiler chickens, with growing periods of just over 50 days each and several days in between flocks, during the approximately 13-month continuous study.

¹²³ *Id.* at 126.

¹²⁴ MICHIEL R.J. DOORN ET AL., EPA, REVIEW OF EMISSIONS FACTORS AND METHODOLOGIES TO ESTIMATE AMMONIA EMISSIONS FROM ANIMAL WASTE HANDLING 1 (2002), *available at* <http://www.epa.gov/nrmrl/pubs/600r02017/600sr02017.pdf> (last visited Mar. 18, 2011).

¹²⁵ Michele M. Merkel, Senior Counsel, Env’tl. Integrity Project, N.Y. State Bar Association presentation at Albany Law School: The Use of CERCLA to Address Agricultural Pollution, at 1 (Sept. 15, 2006), *available at* http://www.environmentalintegrity.org/pdf/publications/The_Use_Cercla.pdf (last visited Mar. 18, 2011).

¹²⁶ Iowa State University and the University of Kentucky, *Tyson Broiler Ammonia Emission Monitoring Project: Final Report*, p. 1-34 (May 1 2007) [hereinafter Tyson Broiler Report].

¹²⁷ See Sierra Club, *Grassroots Stories*, <http://www.sierraclub.org/grassroots/stories/00027.asp> (last visited Mar. 18, 2011).

¹²⁸ Tyson Broiler Report at 2.

The MAEMUs measured ammonia concentration every 30 seconds from three locations inside of the houses and every two hours at one location just outside of the houses.¹²⁹ The researchers converted the raw ammonia concentration data into emission rates, in pounds of ammonia per day per house (lb/d-house).¹³⁰ This resulted in a 12-flock mean emission rate of 30.8 +/- 20.0 lb/d-house.

A 2007 Purdue study conducted as part of EPA's NAEMS study, discussed above in section (b), shows that laying hen operations also emit vast quantities of ammonia. Purdue released a site report for an Indiana NAEMS site, which measured ammonia concentrations and emissions rates inside two barns (Barns 6 and 7) housing laying hens. The report analyzed monitoring results collected between May 12 and June 30, 2007.¹³¹ The monitors recorded the concentration of ammonia in ppm, and then converted those data into emission rates. The researchers calculated average daily mean ammonia emission rates of 252 +/- 99 and 308 +/- 63 kg/day for barns 6 and 7 respectively.¹³²

In December of 2009, EIP finalized a report entitled "A Holiday Gift for Big Poultry: Bush Administration Rushes Emissions Reporting Exemption," which extrapolates from these two studies' emission rates.¹³³ Using the number of broiler chickens and egg laying hens per state,¹³⁴ EIP calculated an estimate of the total pounds of ammonia released by the top ten poultry producing states in 2007 and the total pounds of ammonia released in the top ten states for each type of poultry CAFO.

EIP's report found that, according to these studies' emission factors, poultry operations in just the top ten states released an estimated 700 million tons of ammonia into the air in 2007. These 10 states emit more ammonia from poultry facilities than all other non-agricultural

¹²⁹ *Id.* at 8.

¹³⁰ *Id.* at 1. The results varied significantly between the two houses, primarily due to different manure handling methods: one house received new rice hull bedding and had litter removed mid-way through the study, while the other had the same bedding and no litter de-caking during the study. The house that received new litter after several flocks had significantly lower emissions while the houses had birds in them, but significantly higher average emissions during the downtime between flocks, possibly due to the de-caking activity releasing ammonia. *Id.* at 21. These results underscore the importance of considering waste management practices, emissions from litter stockpiles, and emissions from land application of waste, when evaluating the public health impacts of CAFO ammonia emissions. Thus, even the ammonia emissions estimates in EIP's study, summarized below, do not include all emissions from litter removed from poultry houses.

¹³¹ Purdue University, *National Air Emissions Monitoring Study Data from Layer Site IN2H, May 12 to June 30 2007* at 1, 10, Figure 4 [hereinafter Purdue Study].

¹³² Purdue Study at 15.

¹³³ Environmental Integrity Project, *A Holiday Gift for Big Poultry: Bush Administration Rushes Emissions Reporting Exemption*, (Corrected December 2009), available at http://environmentalintegrity.org/news_reports/Bush_administration.php. [Hereinafter EIP Report] (last visited Mar. 18, 2011).

¹³⁴ As provided by the U.S. Department of Agriculture's *Poultry-Production and Value 2007 Summary*, released April 2008, and the U.S. Department of Agriculture's *Chicken and Eggs*, released November 21, 2008.

industries in the entire U.S. emit combined.¹³⁵ Looking at the two types of poultry production individually, broiler chicken operations in the top ten states¹³⁶ emitted an estimated 481,764,049 pounds of ammonia in 2007, which is greater than eight times the amount of ammonia emissions reported to the Toxic Release Inventory (TRI) by all industrial sources in those ten states combined.¹³⁷ Egg laying operations in the top ten states¹³⁸ emitted an estimated 221,551,888 pounds of ammonia per year.¹³⁹ These emissions approximately triple the amount that all industrial sources in those states combined reported to the TRI.¹⁴⁰

As indicated above, industrial sources must report their ammonia emissions to the TRI under the Emergency Planning and Community Right-to-Know Act (EPCRA).¹⁴¹ The TRI program does not require CAFOs to report emissions, however, even though they emit the dominant share of total ammonia emissions. Consequently, the TRI ammonia totals reported by industries in the top ten states for broilers and egg laying operations bear little relation to the total volume of ammonia released into the air in these states. For instance Georgia, the nation's number one producer of broiler chickens, emitted an estimated 97,618,755 pounds of ammonia from CAFOs in 2007, yet the state's industrial sources combined reported only 11,936,373 pounds of ammonia to the TRI.¹⁴² Similarly Iowa, the nation's number one producer of eggs, emitted an estimated 53,012,347 pounds of ammonia into the air from its layer hen CAFOs, while the state's industrial sources reported only 9,425,300 pounds to the TRI.¹⁴³

Hog CAFOs also emit large quantities of ammonia. The Iowa Study researchers evaluated several peer-reviewed studies of hog CAFO ammonia emissions, establishing a range of emission factors for various stages of hog maturity, including nursery pigs and finishing pigs.¹⁴⁴ These studies indicate that many factors, such as ventilation system, animal maturity, waste storage system, season, and outside temperature significantly affect ammonia emission rates.¹⁴⁵ The highest measured emission rate for a hog nursery included in the Iowa Study, 160 g ammonia per animal unit per day,¹⁴⁶ translates to a daily emission of 353 pounds of ammonia for a facility at the Large CAFO threshold size.¹⁴⁷ The highest reported emissions from a hog finishing facility, 311 g ammonia per animal unit per day during summer,¹⁴⁸ translates to a daily

¹³⁵ EIP Report at 1.

¹³⁶ Georgia, Arkansas, Alabama, Mississippi, North Carolina, Texas, Kentucky, Maryland, Virginia, and Delaware.

¹³⁷ EIP Report Attachment A.

¹³⁸ Iowa, Ohio, Indiana, Pennsylvania, Georgia, Texas, California, Arkansas, North Carolina, and Florida.

¹³⁹ EIP Report Attachment A.

¹⁴⁰ *Id.*

¹⁴¹ See EPA, What is the Toxics Release Inventory Program, at <http://www.epa.gov/TRI/triprogram/whatis.htm> (last visited Mar. 18, 2011).

¹⁴² EIP Report, Attachment A.

¹⁴³ *Id.*

¹⁴⁴ Iowa Study at 48-49.

¹⁴⁵ *Id.*

¹⁴⁶ *Id.* at 49.

¹⁴⁷ 40 C.F.R. §122.23(b)(4).

¹⁴⁸ Iowa Study at 49.

emission of 686 pounds of ammonia for a facility at the Large CAFO threshold size. These studies demonstrate that, particularly during summer, hog CAFOs emit vast quantities of ammonia. Though Iowa leads the nation in hog production, it is not the only state of concern. According to the North Carolina Department of Environment and Natural Resources' 1995 estimates, North Carolina sources released an enormous 355 million pounds of ammonia into the air that year, of which hog operations alone released 166 million pounds.¹⁴⁹

EIP's analysis of EPA's NAEMS data also indicates that most CAFOs monitored emit more than the reportable quantity – 100 pounds – of ammonia on a typical day, and some facilities studied emit thousands of pounds on a typical day.¹⁵⁰ As discussed previously, ammonia emissions also vary significantly over both the short and long term, such that large CAFOs can emit many thousands of pounds of ammonia on certain days. Although NAEMS did not measure ambient ammonia levels in communities near these operations, the sheer volume of total ammonia emissions from CAFOs – particularly poultry CAFOs – creates cause for concern that those living or working near numerous or very large CAFOs may breathe unsafe levels of ammonia in the ambient air.

CAFOs emit the majority of ammonia emissions but remain largely unaccountable for their air pollution. Despite the gap in emissions knowledge EPA's limited TRI reporting system and livestock exemption from CERCLA reporting have created, available emissions research and EIP's analysis of the Tyson and Purdue studies demonstrate the need to regulate CAFO ammonia emissions commensurate with their controlling contribution to total ammonia pollution. EPA should consider these studies' findings as to the enormous quantities of ammonia CAFOs currently emit in certain regions when deciding whether to list ammonia as a criteria pollutant.

ii. CAFOs are geographically concentrated

This vast quantity of airborne ammonia emitted by CAFOs does not exist at equal concentrations throughout the U.S. or throughout certain agricultural states; rather, CAFOs and the ammonia they release are concentrated in certain geographic regions, creating areas with an elevated risk of ammonia-related health effects for nearby rural populations. Many rural communities breathe the emissions from not just one or two CAFO barns, but from many CAFOs, each of which contains numerous barns.

Concentration of CAFOs in certain geographic areas has increased dramatically in recent years, and exists on a far more localized scale than the state-level concentration demonstrated in EIP's poultry emissions report. The Government Accountability Office (GAO) discussed this trend in its 2008 report "Concentrated Animal Feeding Operations: EPA Needs More Information and a Clearly Defined Strategy to Protect Air and Water Quality from Pollutants of

¹⁴⁹ North Carolina Department of Environment and Natural Resources Division of Air Quality, *Status Report on Emissions and Deposition of Atmospheric Nitrogen Compounds from Animal Production in North Carolina*, Table 1 (June 1999), available at <http://daq.state.nc.us/monitor/projects/nstatusreport.pdf> (last visited Mar. 18, 2011).

¹⁵⁰ Hazardous Emissions from Factory Farms at 12-13.

Concern.”¹⁵¹ In its report, GAO concludes that CAFOs are “increasingly clustered within specific geographic areas within a state,”¹⁵² and cites several alarming examples of communities besieged by CAFOs housing many millions of confined animals in small areas.

One such area, comprised of five contiguous counties in North Carolina, alone housed more than 7.5 million hogs and produced as much as 15.5 million tons of manure in 2002.¹⁵³ This increased concentration is not limited to the hog industry. GAO also highlights two California counties in the San Joaquin Valley that contained 535,433 cows in 2002, producing approximately 13.6 million tons of manure that year.¹⁵⁴ Similarly, in Arkansas just two counties had amassed broiler chicken CAFOs housing 14,264,828 chickens in 2002, producing more than 471,000 tons of manure that year.¹⁵⁵

Yet another example of intense livestock concentration is the Delmarva Peninsula, where contract producers raise approximately 568 million broiler chickens per year, generating an estimated 1.1 billion pounds of chicken litter.¹⁵⁶ This averages more than a staggering 104,000 chickens per square mile on the 5,450 square mile peninsula. Experts have raised concerns that such incredible quantities of waste cannot be applied to the surrounding area’s available cropland at agronomic rates;¹⁵⁷ for similar reasons, the emissions from these quantities of manure and numbers of livestock confinements should raise concerns that ambient concentrations of ammonia and other emitted pollutants will exceed safe levels.

Rural residents throughout the U.S. live in close proximity to CAFO production areas and manure application fields – some in areas that contain numerous CAFOs in close proximity to one another, whose ammonia emissions mix in the ambient air and cause significant local re-deposition.¹⁵⁸ EPA should consider the aggregate effects of ammonia emissions on ambient air concentrations in these rural communities and the commensurately higher impact emissions have on public health in these areas with high concentrations of CAFOs.

The growing body of CAFO ammonia emissions research, which includes monitoring both at the source and at nearby residences, collectively compels the conclusion that ambient ammonia air pollution currently surpasses established health benchmarks and thus may reasonably be anticipated to endanger public health. To designate ammonia as a CAA criteria

¹⁵¹ GAO, *Concentrated Animal Feeding Operations: EPA Needs More Information and a Clearly Defined Strategy to Protect Air and Water Quality from Pollutants of Concern* (Sept. 2008) [hereinafter GAO Report].

¹⁵² GAO Report at 5.

¹⁵³ *Id.* at 21.

¹⁵⁴ *Id.* at 22.

¹⁵⁵ *Id.*

¹⁵⁶ Karen Gardner, *Farmer: Chesapeake Bay cleanup requires unity*, FREDERICK NEWS POST, Dec. 3, 2010, available at <http://www.fredericknewspost.com/sections/news/display.htm?storyid=113253> (last visited Mar. 18, 2011).

¹⁵⁷ GAO Report at 22.

¹⁵⁸ See discussion of ammonia transport and fate, *infra* Section V.B.2.ii.

pollutant, EPA does not need to find that all Americans currently breathe unsafe levels of ammonia, or even that residents near CAFOs and other ammonia sources are suffering life-threatening or permanent health effects. On the contrary, the CAA gives EPA significant discretion to enact health protections even if it lacks absolute scientific certainty about the nature or extent of the threat and even if the entire population is not affected.¹⁵⁹

e. Ammonia is a significant precursor to PM_{2.5}, and endangers public health by contributing to violations of the fine particulate NAAQS

The CAA requires EPA to consider criteria pollutant precursors as well as criteria pollutants themselves, by defining “air pollutant” to include “any precursors to the formation of any air pollutant, to the extent the Administrator has identified such precursor or precursors for the particular purpose for which the term “air pollutant” is used.” CAA § 302(g). EPA has identified ammonia as a precursor pollutant to small particulate matter (PM_{2.5}), but does not currently require states to regulate ammonia as a precursor pollutant “unless the State or EPA makes a technical demonstration that emissions of ammonia from sources in the State significantly contribute to PM_{2.5} concentrations in a given nonattainment area.”¹⁶⁰

Although some airborne ammonia will re-deposit close to the emission source, ammonia gas reacts readily with acidic compounds in the air, such as nitric acid, hydrochloric acid, and sulfuric acid, forming small particles known as ammonium aerosols.¹⁶¹ These particles of ammonium nitrate and ammonium sulfate have diameters smaller than 2.5 microns, and thus qualify as PM_{2.5} – a regulated CAA criteria pollutant. EPA has recognized the health impacts of particulate pollution, and PM_{2.5} in particular, for decades, so this petition will not address them in detail. EPA’s current NAAQS for PM_{2.5} are meant to protect the public health and welfare from the respiratory symptoms, decreased lung function, aggravated asthma symptoms, chronic bronchitis, irregular heartbeat, heart attacks, and premature death associated with small particle pollution.¹⁶² These NAAQS do not require ammonia regulation, however, despite recent research indicating that ammonia contributes significantly to PM_{2.5}.

One recent study clarifies the role ammonia plays in PM_{2.5} formation and seasonal PM_{2.5} variations.¹⁶³ Researchers used the Community Multiscale Air Quality chemical transport model¹⁶⁴ to predict the environmental impact of ammonia emissions in PM_{2.5} non-attainment

¹⁵⁹ See discussion of EPA’s Sulfur Dioxide Rule, *infra* Section VI.

¹⁶⁰ Rich Damberg, EPA Office of Air Quality Planning and Standards, *Policies for Addressing PM_{2.5} Precursor Emissions* (June 20, 2007) at Slide 8.

¹⁶¹ Aneja at 516.

¹⁶² EPA, Particulate Matter: Health and Environment, <http://www.epa.gov/pm/health.html> (last visited Mar. 18, 2011).

¹⁶³ R. W. Pinder et al., *Environmental Impact of Atmospheric NH₃ Emissions Under Present and Future Conditions in the Eastern United States*, 35 Geophysical Res. Letters (June 2008) at 2 [hereinafter Pinder].

¹⁶⁴ See EPA, Atmospheric Modeling and Analysis Division, Community Multiscale Air Quality (CMAQ), <http://www.epa.gov/AMD/CMAQ/> (last visited Mar. 18, 2011).

areas, considering future scenarios in which EPA's recently amended regulations have reduced emissions of oxides of nitrogen (NO_x) and sulfur oxides (SO_x). The authors explain that although ammonia can react with either NO_x or SO₂ to form small particulates, in the absence of ammonia NO_x will stay in gaseous form, while SO₂ can readily react with other compounds to form other small particles. Because in winter a higher proportion of PM_{2.5} is ammonium nitrate (formed from ammonia and NO_x) than in summer, the "sensitivity of PM_{2.5} to ammonia emissions reductions" is greatest in winter¹⁶⁵ and thus reductions in winter ammonia emissions may significantly reduce PM_{2.5}. This conclusion supports findings in previous studies that under certain circumstances winter ammonia emissions reductions can be an even "more effective and less costly control strategy for PM_{2.5} than reductions in NO_x and SO₂."¹⁶⁶ The modeling further suggests that "NH₃ emission controls will continue to be an effective strategy to achieve further reductions in winter PM_{2.5}, even considering the planned reductions in NO_x and SO₂ emissions."¹⁶⁷

Other studies have estimated ammonia's contribution to PM_{2.5} and the contribution of ammonia from livestock in particular. One study looked at the constituents and sources of PM_{2.5} in the eastern U.S., concluding that "ammonia comprises a significant portion of the PM_{2.5} mass" in the region – 47 percent.¹⁶⁸ Penn State researchers have looked specifically at livestock's contribution to ammonium nitrate formation. Using the conservative estimate that livestock contribute only 51 percent of total ammonia emissions, the study found that livestock ammonia emissions lead to the formation of 9 to 11 percent of total U.S. PM_{2.5}, while in winter in the Upper Midwest this contribution may be as high as 20 percent.¹⁶⁹ EPA's failure to consider ammonia's localized and seasonal effects on PM_{2.5} concentrations, and to require state regulation of ammonia sources in PM_{2.5} non-attainment areas, contravenes current research.

The evidence provided in this petition demonstrates that ammonia clearly meets the CAA criteria pollutant standard: ammonia emissions cause or contribute to air pollution – both ammonia itself and PM_{2.5} – that may reasonably be anticipated to endanger public health. EPA should make an endangerment finding, designate ammonia as a criteria pollutant, and establish primary NAAQS that will protect public health with an adequate margin of safety.

2. Ammonia emissions endanger public welfare

CAA § 109(b)(2) requires EPA to establish secondary NAAQS for criteria pollutants, set at levels that protect the public welfare "from any known or anticipated adverse effects

¹⁶⁵ Pinder et al. at 2.

¹⁶⁶ *Id.* at 1.

¹⁶⁷ *Id.* at 4.

¹⁶⁸ Natalie Anderson et al., *Airborne Reduced Nitrogen: Ammonia Emissions from Agriculture and Other Sources*, 29 *Env't Int'l* (2003) at 277.

¹⁶⁹ Alexander N. Hristov, Associate Professor of Dairy Nutrition, Penn State Department of Dairy and Animal Science, *Livestock Contribution to Fine Particulate Matter (PM_{2.5}) in the U.S.*, 16 February 2009, available at <http://www.das.psu.edu> (search "particulate matter") (last visited Mar. 18, 2011).

associated with [the criteria pollutant] in the ambient air.” Public welfare has many dimensions, which include environmental and economic impacts as well as psychological health and quality of life.

CAA §302(h) defines “welfare” broadly and non-exclusively:

“[a]ll language referring to effects on welfare includes, but is not limited to, effects on soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility, and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being, whether caused by transformation, conversion, or combination with other air pollutants.”

This open-ended definition demonstrates Congress’ understanding that air pollution has numerous and complex adverse effects, and its intent that EPA should exercise its broad regulatory authority to mitigate any and all of them. This section will provide evidence of the public welfare impacts of ammonia emissions, alone and in combination with other CAFO emissions, on personal comfort and well-being, water and soil quality, property values, and visibility.

i. Ammonia emissions threaten personal comfort and well-being

Airborne ammonia most obviously impacts a person’s personal comfort and well-being through odor. Airborne ammonia has a pungent, unpleasant smell often associated with urine. Indeed, many complaints from communities that live close to CAFOs concern the effects of the odor emanating from the CAFOs on their daily lives.¹⁷⁰ These nuisance effects of ammonia odor on important aspects of public welfare exist independent of the public health effects from more elevated ambient concentrations. The odor released from CAFOs typically includes a mixture of hydrogen sulfide (H₂S), volatile organic compounds (VOCs), ammonia, and other gases.¹⁷¹ However, although airborne ammonia is only one component of the cumulative odor emitted from CAFOs, they release it in vast quantities.

Moreover, though many pollutants from CAFO emissions combine to cause the nuisance odors that impact several aspects of public welfare, this does not lessen EPA’s obligation to address ammonia’s public welfare impacts. Congress anticipated this scenario when drafting the CAA, and specifically included effects “caused by... combination with other air pollutants” in its definition of welfare. CAA § 302(h). Ammonia is a primary pollutant in CAFO air emissions, emitted in large quantities from CAFOs housing all types of livestock, and EPA should act to

¹⁷⁰ See, e.g., Iowa Study at 71.

¹⁷¹ EPA, Animal Feeding Operations Air Agreements, <http://www.epa.gov/compliance/resources/agreements/caa/cafo-agr.html> (last visited Mar. 18, 2011). See also Schiffman, et al., *Quantification of odors and odorants from swine operations in North Carolina*, 108 Agric. and Forest Meteorology (2001).

mitigate the community well-being and public welfare impacts of ammonia in combination with other CAFO air pollution.

The 2008 Pew Commission Report surveyed research on the social and community impacts of CAFO emissions. The Commission concluded that residents near CAFOs “are subject to air emissions that, although lower in concentration [than worker exposures], may significantly affect certain segments of the population.”¹⁷² After reviewing existing research, the Commission identified community physical and mental health effects such as respiratory symptoms and neurobehavioral effects such as depression.¹⁷³ The Commission also considered the effect of CAFO odor compounds on mood, and determined that due to the toxicity and odor of ammonia and other CAFO emissions it is “not surprising” that existing studies have shown “increased rates of neurobehavioral symptoms such as depression.”¹⁷⁴

The North Carolina study previously discussed evaluated quality of life factors in addition to health symptoms.¹⁷⁵ The study evaluated quality of life indicators by calculating the number of days that the community members had to stay inside or keep windows closed during good weather. Because those living near the hog CAFO had to stay indoors significantly more often than the other groups, the study concluded that proximity to the hog CAFO reduced this community’s quality of life.¹⁷⁶

Another North Carolina study used a “Profile of Mood States” test to compare the psychological state of 44 community members living close to a large swine confinement to the psychological state of community members who did not live close to the swine confinement.¹⁷⁷ The study showed that members living close to the swine confinement experienced more anger, tension, and depression than the control group; they also suffered physical effects, experiencing more fatigue and confusion than the control group.¹⁷⁸

The Iowa Study also reviewed numerous polls and surveys of the nuisance effects of livestock operations, including odors and air pollution. The Study found that rural residents find livestock odors a major nuisance, and that odors, rather than traffic, noise, dust, flies, or other problems, create the significant majority of the nuisance issues arising from CAFOs in close proximity. Moreover, those surveyed reported that larger farms were a greater nuisance than smaller ones.¹⁷⁹

¹⁷² Pew Commission Report at 17.

¹⁷³ *Id.*

¹⁷⁴ *Id.*

¹⁷⁵ Steve Wing and Susanne Wolf, *supra* note 107.

¹⁷⁶ *Id.* at 236; Iowa Study at 150.

¹⁷⁷ Iowa Study at 137, *citing* Schiffman et al., *The Effect of Environmental Odors Emanating from Commercial Swine Operations on the Mood of Nearby Residents*, 17 Brain Res. Bulletin (1995).

¹⁷⁸ *Id.*

¹⁷⁹ Iowa Study at 149-50.

These studies detail some of the difficult-to-quantify effects of CAFO ammonia emissions on personal comfort and well-being. Emotions such as depression, anger, and fatigue play a central role in personal well-being, and therefore in public welfare. Similarly, the degree to which rural residents may open their windows, go outside, and otherwise enjoy their property directly affects both comfort and well-being. When rural citizens lack these basic rights and comforts – things most Americans take for granted – the public welfare suffers. The authors of the Iowa Study drew a similar conclusion, reporting that CAFO neighbors often hesitate to make social plans at their houses because they have no control over what the air quality will be like on a certain day, and as a result, CAFOs reduce social capital.¹⁸⁰

The Iowa Study and Pew Commission Report also found correlations between increased size and industrialization of livestock operations and overall social and economic decline. One such study noted by both the Iowa and Pew reports contrasted family farm and industrial agricultural areas in 98 counties across several states, concluding that farm size and mechanization “significantly predict declining community conditions not merely at the local agricultural community level, but in the entire county.”¹⁸¹ The Iowa Study’s review of Midwest CAFO research also found “tendencies of economic decline in communities with greater concentration of CAFOs.”¹⁸² While these studies do not attempt to discern the share of these impacts attributable directly to ammonia and other air emissions, these emissions cause demonstrated adverse welfare impacts and clearly contribute to the observed trends of social decline. Because numerous peer-reviewed studies demonstrate that ammonia emissions from CAFOs decrease personal comfort as well as social and economic well-being, ammonia meets the CAA definition of a pollutant which can reasonably be anticipated to endanger public welfare.

ii. Ammonia emissions re-deposit, polluting waterways and acidifying soils

The CAA definition of welfare impacts specifically includes impacts to water, vegetation, and soil. CAA § 302(h). Ammonia emissions have far-reaching environmental impacts, and affect public welfare by polluting water and land as well as air. While transport distances vary based on numerous environmental and climate factors, airborne ammonia eventually leaves the atmosphere, either as ammonia or after conversion to ammonium aerosol particles, through the processes of either dry or wet deposition.¹⁸³ Dry deposition occurs when the ammonia falls to earth without the presence of precipitation, while wet deposition occurs when ammonia returns

¹⁸⁰ *Id.* at 150.

¹⁸¹ *Id.* at 148, quoting MacCannell D. Industrial agriculture and rural community degradation. In Swanson LE, ed. Agriculture and community change in the U.S.: The Congressional research reports at 63 (pp. 15-75). Boulder, CO: Westview Press (1988). See also Pew Commission Report at 42-43.

¹⁸² Iowa Study at 148.

¹⁸³ U.S. Department of the Interior, U.S. Geological Survey (USGS), *Atmospheric Deposition Program of the U.S. Geological Survey: Fact Sheet FS-112-00 p. 1-6*, (December 2000) at 1, available at <http://bqs.usgs.gov/AcidRain/program.pdf> [hereinafter USGS Fact Sheet] (last visited Mar. 18, 2011).

to the earth via rain, snow, sleet, or fog.¹⁸⁴ This deposition can add nitrogen directly to waterways, or can add nitrogen to land areas, acidifying soils and ultimately adding to water pollution through surface runoff.

Ammonia gas emissions have a typical transport time ranging from one to five days.¹⁸⁵ Because “[p]recipitation readily removes most reactive nitrogen compounds, such as ammonia and nitrogen oxides, from the atmosphere,”¹⁸⁶ a significant percentage of volatilized ammonia can re-deposit within these first few days. Ammonia that converts to ammonium aerosol particles rather than depositing directly has a much longer average transport time, ranging from one to fifteen days.¹⁸⁷ As a result, the rate of conversion from ammonia gas to ammonium aerosol particles will significantly affect deposition patterns, as ammonium aerosols may travel thousands of kilometers before re-depositing.¹⁸⁸

Additional factors also affect ammonia conversion, transport and deposition – including the prevalence of NO_x and SO₂ in the atmosphere, temperature, and precipitation patterns – making models and predictions of ammonia deposition impacts extremely complex.¹⁸⁹ However, existing research demonstrates that ammonia emissions, particularly in areas with high concentrations of CAFOs, can have severe local and regional effects on water quality. Watersheds in regions with numerous sources of ammonia emissions, such as the Chesapeake Bay, North Carolina, and the Mississippi River Corridor, receive high levels of overall nitrogen and ammonium deposition.¹⁹⁰

When ammonia re-deposits into surface water, it endangers public welfare by polluting the water with excess nitrogen. The eutrophication process occurs when excess nutrients, in this case nitrogen in ammonia, enter surface water, thereby upsetting the nutrient balance of the waterway and contributing to increased algal growth.¹⁹¹ Due to the nutrient overload in the water, algae initially flourish, but as these algae die off, the decomposition process depletes the water of its oxygen content.¹⁹² Extreme cases of eutrophication lead to hypoxic “dead zones,” such as the more than 15,000 square kilometer area in the Gulf of Mexico devoid of aquatic life.¹⁹³ Due in large part to increased nutrient loads from changed agricultural practices in the

¹⁸⁴ USGS Fact Sheet at 1.

¹⁸⁵ Viney P. Aneja et al., *Ammonia Assessment from Agriculture: U.S. Status and Needs*, 37 *Env'tl. Quality*, 2008, at 516 [hereinafter Aneja].

¹⁸⁶ USGS Fact Sheet at 2.

¹⁸⁷ Aneja at 516.

¹⁸⁸ Aneja at 515-16.

¹⁸⁹ See generally Pinder, *supra* note 163.

¹⁹⁰ USGS Fact Sheet at 3, see Figure 5; See also National Atmospheric Deposition Program, 2009 ammonium ion wet deposition map, <http://nadp.sws.uiuc.edu/> (last visited Mar. 18, 2011).

¹⁹¹ USGS Fact Sheet at 2.

¹⁹² *Id.*

¹⁹³ Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, *Moving Forward on Gulf Hypoxia Annual Report 2009*, 4 (2009), available at <http://www.epa.gov/msbasin/implementation.htm> (last visited Mar. 18, 2011).

Mississippi River watershed over the past 50 years, this dead zone is currently the largest in the U.S. and the second largest in the world.¹⁹⁴

Though all sources of nitrogen and other nutrients contribute to eutrophication of waterways, in some watersheds, nitrogen deposition comprises a significant fraction of the total nitrogen load. One study of nutrient pollution sources found that coastal areas that export large amounts of nitrogen via water received 18 percent of that nitrogen from deposition – even more than the 15 percent from livestock waste runoff.¹⁹⁵ In the Chesapeake Bay, one of the United States’ most recreationally, culturally, and economically significant water bodies, EPA has estimated that more than a third of the total nitrogen pollution entering the Bay comes from air deposition.¹⁹⁶ Areas with the highest concentrations of CAFOs see even greater impacts from nitrogen deposition; for example, research indicates that “[a]tmospheric deposition of nitrogen compounds may contribute as much as 35 to 60% of total nitrogen loading to North Carolina coastal waters.”¹⁹⁷

Re-deposited airborne ammonia also comprises a significant fraction of total nitrogen deposition in areas with ammonia emission sources; studies demonstrate that ammonia sources significantly affect overall nitrogen deposition on a local and regional scale. Pinder et al. used EPA’s Community Multiscale Air Quality (CMAQ) chemical transport model to map nitrogen deposition, and found that total nitrogen deposition near ammonia sources increases 10 to 40 percent.¹⁹⁸ Another study collected precipitation and measured its ammonium concentration, then used regression modeling to analyze the impact of ammonia sources on regional deposition.¹⁹⁹ The researchers found that areas with densely grouped CAFOs “will have a local impact” on both ammonia and ammonium aerosol deposition, and “may have a regional influence” on ammonium deposition.²⁰⁰ The study found that CAFO emissions caused increases in ammonium deposition as far as 80 kilometers away.²⁰¹

Despite an atypically small dead zone in 2009, the most recent five-year average size of the Gulf dead zone was 15,650 square kilometers. *Id.*

¹⁹⁴ EPA, *Hypoxia in the Northern Gulf of Mexico, an Update by the EPA Science Advisory Board*, EPA-SAB-08-003, 10-12 (Dec. 2007), available at:

[http://yosemite.epa.gov/sab/SABPRODUCT.NSF/C3D2F27094E03F90852573B800601D93/\\$File/EPA-SAB-08-003complete.unsigned.pdf](http://yosemite.epa.gov/sab/SABPRODUCT.NSF/C3D2F27094E03F90852573B800601D93/$File/EPA-SAB-08-003complete.unsigned.pdf) (last visited Mar. 18, 2011).

¹⁹⁵ Robert W. Howarth et al., *Sources of Nutrient Pollution to Coastal Waters in the United States: Implications for Achieving Coastal Water Quality Goals*, 25 *Estuaries* 656, 668 (Aug. 2002) [hereinafter *Sources of Nutrient Pollution*].

¹⁹⁶ EPA, Office of Enforcement and Compliance Assurance, *Chesapeake Bay Compliance and Enforcement Strategy at 2* (May 2010) [hereinafter *Chesapeake Enforcement Strategy*], available at

<http://www.epa.gov/oecaerth/civil/initiatives/chesapeake-strategy-enforcement.pdf> (last visited Mar. 18, 2011).

¹⁹⁷ Aneja at 517.

¹⁹⁸ Pinder at 1.

¹⁹⁹ John T. Walker et al., *Atmospheric Transport and Wet Deposition of Ammonium in North Carolina*, 34 *Atmospheric Env’t.*, 2000.

²⁰⁰ *Id.* at 3408.

²⁰¹ *Id.* at 3416.

The National Atmospheric Deposition Program's data lend support to these findings, showing that ammonium deposition has been heavily concentrated in the livestock-intensive Upper Midwest over the past decade and is increasing in concentration in the region.²⁰² EPA's own findings in the Chesapeake Bay also show the regional influence of ammonia on Bay water quality. Despite the thousands of point sources discharging nitrogen directly to the Bay via surface waters, the agency's Office of Enforcement and Compliance Assurance (OECA) has recently estimated that six percent of the total nitrogen loadings in the Bay come from deposition of emissions from livestock manure and fertilized soil.²⁰³

Moreover, the results of the CMAQ modeling study suggest that increased regulation of NO_x and SO₂ will increase both ambient ammonia concentrations and localized nitrogen deposition near ammonia sources in the future. Increased CAA controls on NO_x and SO₂ will reduce ambient levels of these pollutants, which will reduce conversion of ammonia into ammonium aerosols that have greater transport potential.²⁰⁴ Ammonia emissions are also expected to rise due to projected increases in livestock production and concentration. As a result of both factors, more ammonia will re-deposit within a shorter distance from emissions sources.²⁰⁵ Specifically, the modeling indicated that "the total nitrogen deposition decreases in the future, except near ammonia emission sources. The largest future increases in total nitrogen deposition can be found in and around areas of high ammonia emissions, including the Delmarva Peninsula, eastern North Carolina, and northeastern Georgia."²⁰⁶

Additional studies have linked those areas where ammonia deposition plays a significant role in nitrogen loadings with areas near intensive animal production,²⁰⁷ indicating again that much volatilized ammonia re-deposits within a small range of its source and has a considerable effect on water quality. Moreover, it is not only animal numbers and proximity, but also livestock production methods, that affect nitrogen deposition; the use of CAFO livestock production systems increases the total amount of ammonia volatilized from livestock, and therefore the amount that eventually re-deposits in waterways. Nutrient researchers have found that keeping cows on pasture, as opposed to in barns, reduces volatilization of ammonia by more than half.²⁰⁸ These studies indicate that protecting water quality from nutrient pollution requires EPA to consider and regulate ammonia emissions from CAFOs.

²⁰² National Atmospheric Deposition Program, Map Viewer, <http://nadp.sws.uiuc.edu/maps/> (view Network: NTN, Map Type: Deposition, Analyte: NH₄) (last visited Mar. 18, 2011).

²⁰³ Chesapeake Enforcement Strategy at 9. An additional 17 percent of the Bay's total nitrogen load comes from animal manure directly via water. *Id.*

²⁰⁴ Pinder at 1.

²⁰⁵ *Id.* at 3.

²⁰⁶ *Id.* at 4.

²⁰⁷ Donald F. Boesch, *Challenges and Opportunities for Science in Reducing Nutrient Over-enrichment of Coastal Ecosystems*, 25 *American Scientist* 896 (Aug. 2002).

²⁰⁸ Sources of Nutrient Pollution at 663.

Ammonia deposition onto land also degrades soil quality. According to the National Atmospheric Deposition Program, “[w]hen an ammonium ion deposits to a soil surface, it can increase soil acidity through nitrification reactions, releasing hydrogen ions and converting ammonium to nitrate.”²⁰⁹ Acidified soil provides poor growing conditions for vegetation by depleting calcium and other nutrients from the soil, mobilizing inorganic aluminum, and increasing the accumulation of nitrogen and sulfur in the soil.²¹⁰ High levels of aluminum can be toxic to plants, fish, and other organisms.²¹¹ In addition, when nitrogen deposits onto soil it benefits species that need a large supply of nitrogen, resulting in these species overtaking those adapted to a limited nitrogen supply.²¹² Thus nutrient enrichment can degrade terrestrial ecosystems just as eutrophication devastates aquatic ecosystems. Recent studies suggest that acidic deposition has played a part in the decrease in tree species such as red spruce and sugar maple in the eastern United States.²¹³

In accordance with the CAA’s broad mandate to protect against threats to public welfare, this petition requests that EPA consider the entire nitrogen cycle when regulating ammonia. Public welfare encompasses the social benefits derived from protecting clean water, healthy and productive soils, natural vegetation, and the enjoyment of natural resources. Ammonia deposition significantly degrades water quality, and in doing so diminishes use, enjoyment, and economic value of surface waters for fishing, recreation, and municipal use. Ammonia deposition also harms soil quality, which lowers cropland productivity as well as the diversity, health, and recreational value of forest ecosystems. Regulating ammonia as a criteria pollutant would reduce total ammonia air emissions and the resulting deposition of ammonia into surface waters in the most polluted areas. Adequate regulation through the implementation of protective secondary NAAQS would benefit both air and water quality, thereby furthering EPA’s mission to protect public welfare from air pollution.

iii. Ambient ammonia reduces property values

Ammonia emissions also harm public welfare by causing damage to and deterioration of property and economic values. CAA § 302(h). Much of this harm to property value and rural economies stems from the quality of life issues already discussed. CAFOs may adversely affect quality of life and property value nearby in several ways, such as air pollution, water pollution, noise, dust, flies, and increased traffic. But as discussed previously, the Iowa Study found that

²⁰⁹ National Atmospheric Deposition Program, Passive Ammonia Monitoring Network <http://nadp.sws.uiuc.edu/nh3Net/> (last visited Mar. 18, 2011).

²¹⁰ Driscoll, Charles, et. al. *Effects of acidic deposition on forest and aquatic ecosystems in New York State*. Environmental Pollution 123 (2003) 327–336 [hereinafter Driscoll], available at <http://www.esf.edu/hss/HF%20Ref%20PDF/EvnPol.123.327.336.pdf> (last visited Mar. 18, 2011).

²¹¹ *Id.*

²¹² Dep’t of Environment, Food & Rural Affairs, *Ammonia in the UK 25* (2002), available at <http://www.defra.gov.uk/environment/quality/air/airquality/publications/ammonia/documents/ammonia-in-uk.pdf> (last visited Mar. 18, 2011).

²¹³ Driscoll at 327–336.

citizens near CAFOs have identified odor and air pollution as the leading CAFO nuisances contributing to decreased quality of life.²¹⁴ In many rural communities, homeowners living near CAFOs find themselves unable to sell their homes and relocate because CAFO air pollution, including ammonia emissions, makes their home undesirable, thereby dramatically lowering its market value. Both case law and academic research reflect a growing acceptance of the fact that CAFOs have an adverse economic impact on nearby residences. Odor and air pollution have a negative effect on quality of life, and therefore significantly affect the amount a buyer will be willing to pay.

In one recent case, *Darnall Ranch, Inc. v. Banner County Board of Equalization*, the Supreme Court of Nebraska held that the state tax board acted unreasonably and arbitrarily in failing to adjust Darnall's home value downward due to its proximity to a large cattle feedlot.²¹⁵ Discussing a prior hog CAFO case, the Court stated plainly that "[n]o reasonable fact finder could conclude that in the real estate marketplace, a potential buyer would not notice, and react economically, to having a large hog facility very nearby while living in a remote location."²¹⁶ In 2002, an Iowa District Court similarly held that the construction of a large hog CAFO reduced one neighbor's property value by \$50,000, and awarded \$100,000 in damages.²¹⁷

Economic studies have also found that CAFOs reduce the value of nearby property. One Missouri study found that every Missouri CAFO lowered surrounding property values by approximately \$2.68 million.²¹⁸ This translated to an average value loss of 6.6 percent within a three-mile radius, and an average value loss of more than 88 percent for those properties within a quarter mile of the CAFO.²¹⁹ The Union of Concerned Scientists roughly extrapolated this finding, concluding that if every CAFO had a similar impact, CAFOs cost the United States as much as \$26 billion in lowered property values.²²⁰

The Appraisal Journal has also addressed how CAFOs impact property values; a 2001 article on the issue advised that appraisers should consider the effects of nearby CAFOs on use and enjoyment of property when evaluating rural homes. The author reviewed published research and several case studies on the effects of CAFOs on property value, concluding that "diminished marketability, loss of use and enjoyment, and loss of exclusivity can result in a

²¹⁴ Iowa Study at 149-50.

²¹⁵ *Darnall Ranch, Inc. v. Banner Co. Bd. of Equal.*, 753 N.W.2d 819 (Neb. 2008).

²¹⁶ *Id.* at 831, quoting *Livingston v. Jefferson Cty. Bd. of Equal.*, 640 N.W.2d 426 at 437 (2002).

²¹⁷ *Judge awards Iowa couple \$100,000 in hog lot lawsuit*, AMARILLO GLOBE NEWS, Jan. 12, 2002, available at http://www.pmac.net/AM/hoglot_lawsuit.html (last visited Mar. 18, 2011). For additional cases finding devaluation of property from nearby CAFOs, see <http://www.factoryfarmtaxprotest.org/cases.htm>.

²¹⁸ Mubarak, H., T.G. Johnson, and K.K. Miller. 1999. *The impacts of animal feeding operations on rural land values*. Report R-99-02. College of Agriculture, Food and Natural Resources, University of Missouri–Columbia.

²¹⁹ *Id.*

²²⁰ Union of Concerned Scientists, *CAFOs Uncovered: The Untold Costs of Confined Animal Feeding Operations* (April 2008) at 5.

diminishment ranging from 50% to nearly 90% of otherwise unimpaired value.”²²¹ A Pennsylvania study has since found that the prices of homes adjacent to CAFOs decrease once the total live weight of confined animals exceeds 200,000 pounds.²²²

A community located in Princess Anne, Maryland puts property value impacts into perspective. As has happened in rural communities throughout the U.S., homeowners purchased houses on a rural residential street, and large poultry CAFOs subsequently moved in and surrounded the homes at close proximity. As this photograph shows, formerly desirable homes are now, among other things, exposed to ammonia pollution from all directions.²²³ Common sense dictates that such a community transformation, with accompanying air and water pollution, traffic, dust, noise, and flies, will affect the price any potential buyer would be willing to pay. CAFO air pollution, including ammonia, plays a central role in decreased property values, thereby harming public welfare.

Princess Ann, Maryland, February 5, 2009



²²¹ J.A. Kilpatrick, *Concentrated Animal Feeding Operations and Proximate Property Values*, 39 *The Appraisal J.* 3 (2001) at 306.

²²² R.C. Ready and C.W. Abdalla, *The Amenity and Disamenity Impacts of Agriculture: Estimates from a Hedonic Pricing Model*, 87 *Am. J. of Agric. Econ.* 2 (2005) at 314-326.

²²³ Princess Anne, MD on February 5, 2009, photograph from the Assateague Coastal Trust and the Assateague COASTKEEPER.

iv. Ambient ammonia impairs visibility in pristine areas

Ammonia emissions also harm public welfare by impairing visibility and damaging property and economic values in scenic areas. EPA has assessed the impact of air pollution on visibility, finding that “[i]n our nation's scenic areas, the visual range has been substantially reduced by air pollution. In eastern parks, average visual range has decreased from 90 miles to 15-25 miles. In the West, visual range has decreased from 140 miles to 35-90 miles.”²²⁴ Ammonia has significantly contributed to this damage. Emissions research has established that the reactive nitrogen in ammonia “has a variety of environmental consequences including acidification and eutrophication, photo-chemical air pollution [and] reduced visibility.”²²⁵ As discussed, ammonia gas reacts with nitrous oxides and sulfur dioxide to form small aerosol particles harmful to human health; these same light-scattering aerosol particles do further damage by forming the regional haze that limits visibility in many of the nation’s scenic and wild places.²²⁶

For example, the Oregon Department of Environmental Quality has identified ammonia emissions – specifically emissions from the region’s dairy CAFOs – as a significant contributor to regional haze and impaired visibility in the Columbia Gorge National Scenic Area.²²⁷ State officials also recognize that ammonia’s contribution to acid rain in the Gorge threatens cultural and natural resources.²²⁸ EPA must consider these impacts when assessing ammonia’s effects on public welfare, and should establish secondary NAAQS that will protect visibility in wilderness and culturally significant areas for enjoyment by all Americans.

C. Ammonia in the ambient air results from numerous stationary sources

To qualify for listing as a criteria pollutant, ammonia must exist in the air as a result of “numerous or diverse mobile or stationary sources.” CAA § 108(a)(1)(B). Ammonia meets these threshold requirements, because CAFOs qualify as stationary sources, and numerous CAFOs emit ammonia into the ambient air.

1. CAFOs are stationary sources

Section 302(z) of the CAA defines stationary sources broadly, stating “[t]he term “stationary source” means generally any source of an air pollutant except those emissions

²²⁴ EPA, Visibility: Basic Information, *available at* <http://epa.gov/oar/visibility/what.html> (last visited Mar. 18, 2011).

²²⁵ Aneja at 517.

²²⁶ Or. Dep’t of Env’tl. Quality, Fact Sheet: Columbia Gorge Air Quality Strategy Report (2008), *available at* http://www.deq.state.or.us/aq/factsheets/08aq002_gorge.pdf (last visited Mar. 18, 2011).

²²⁷ *Id.*

²²⁸ *Id.*

resulting directly from an internal combustion engine for transportation purposes or from a nonroad engine or nonroad vehicle as defined in section 7550 of this title.”

CAFOs clearly meet the definition of stationary source: they emit ammonia, an air pollutant, into the air and are not internal combustion engines, nonroad engines, or nonroad vehicles. Under the statute, “any” other source of an air pollutant qualifies as a stationary source. Thus, the CAA’s broad language indicates that the law does not limit the term “stationary source” to any particular sector, and CAFOs qualify as stationary sources under CAA § 302(z).

2. CAFOs are numerous

Many thousands of CAFOs contribute to air pollution throughout the United States. Though the CAA does not set a threshold number for “numerous” sources and case law does little to clarify this standard,²²⁹ these facilities exist in thousands of rural communities throughout the U.S., and do not only affect a small area or specific group of people. EPA’s Final CAFO Rule identified an estimated total of 20,685 CAFOs nationwide in 2008.²³⁰ In contrast, EPA regulates SO₂ as a criteria pollutant, 73 percent of which comes from the nation’s 5,400 power plants.²³¹ Under any consistent interpretation of the term, CAFOs are numerous and therefore meet the CAA “numerous or diverse sources” requirement for stationary sources of designated criteria pollutants.

D. EPA has not yet issued air quality criteria for ammonia

Ammonia also satisfies the final CAA § 108(1)(C) requirement for listing as a criteria pollutant because EPA has not yet issued air quality criteria for the pollutant and did not do so before December 31, 1970.²³²

Ammonia therefore meets all of the legal requirements for listing under §108 of the CAA: ammonia is a pollutant as defined by the CAA, emissions of which cause or contribute to air pollution which may reasonably be anticipated to endanger both public health and public

²²⁹ In *NRDC v. Train*, 545 F.2d 320 (2nd Cir. 1976), EPA conceded that lead-emitting automobiles were “numerous or diverse mobile or stationary sources,” and thus the court did not have to address the issue and did not set a threshold for numerous sources. *Id.* at 324. No other case petitioners are aware of clarifies the requirement that sources be numerous.

²³⁰ Revised National Pollutant Discharge Elimination System Permit Regulation and Effluent Limitations Guidelines for Concentrated Animal Feeding Operations in Response to the Waterkeeper Decision: Final Rule, 40 C.F.R. Parts 9, 122, 412 (2008); 73 Fed. Reg. 70418 at 70469-70470.

²³¹ EPA, Fact Sheet: Revisions to the National Ambient Air Quality Standard, Monitoring Network, and Data Reporting Requirements for Sulfur Dioxide, *available at* <http://www.epa.gov/air/sulfurdioxide/pdfs/20100602fs.pdf> (last visited Mar. 18, 2011); U.S. Energy Information Administration, Frequently Asked Questions, http://www.eia.doe.gov/ask/electricity_faqs.asp#coal_plants (last updated Jan. 24, 2011).

²³² As discussed *infra* Section VII, an EPA “plan” to issue air quality criteria for a pollutant is not a requirement for listing; once EPA makes findings under CAA § 108(a)(1)(A) and (B), listing becomes mandatory.

welfare, the emissions are present in the ambient air as the result of numerous stationary sources, including CAFOs, and EPA has yet to issue air quality criteria for ammonia.

VI. EPA CURRENTLY REGULATES SIMILAR EXPOSURES UNDER THE NAAQS PROGRAM

EPA's existing NAAQS already regulate sulfur dioxide (SO₂), a criteria pollutant with characteristics similar to ammonia, and which requires standards similar to those that are necessary to protect public health and welfare from ammonia pollution. As with brief exposures to SO₂, acute ammonia exposures pose a public health threat. And similar to SO₂, which EPA has found does not affect the entire U.S. public but rather impacts pockets of the population near major sources, ammonia emissions primarily impact geographically discrete rural communities throughout the U.S.

EPA has regulated SO₂ as a criteria pollutant since 1971.²³³ To protect public health from exposure to SO₂ emitted by power plants and industrial facilities, EPA initially set a 24-hour standard of 140 ppb and a one-year standard of 30 ppb.²³⁴ However, subsequent research on the health effects of SO₂ led EPA to determine that short-term exposures – between 5 minutes and 24 hours – pose the most significant health threats, and therefore primary NAAQS should protect health from short-term spikes in SO₂ concentrations. These acute SO₂ exposures can worsen asthma symptoms and cause respiratory effects such as narrowing of the airways.²³⁵ To better protect vulnerable citizens from short-term SO₂ exposures, EPA recently revoked both the 24-hour and the one-year primary NAAQS and replaced them with a one-hour primary NAAQS of 75 ppb.²³⁶

EPA's new one-hour SO₂ NAAQS reflects a growing understanding of the acute risks posed by certain toxic emissions, and provides the necessary framework to similarly regulate ammonia. EPA's own ammonia AEGLs document the risks of acute ammonia exposures; the agency's research reports the potential for adverse health effects at concentrations of 30 ppm after as few as 10 minutes.²³⁷ Moreover, EPA's NAEMS data show that ammonia emissions from CAFOs fluctuate significantly, exposing nearby residents to short-term spikes in ammonia concentrations that exceed both levels and durations of concern.²³⁸ EPA should evaluate available ammonia emissions data, considering both existing health-based exposure standards and heightened health effects of mixed-pollutant exposures, and establish a standard that will protect the public from the acute ammonia health effects it determines are likely to occur near

²³³ Primary National Ambient Air Quality Standard for Sulfur Dioxide; Final Rule, 75 Fed. Reg. 35,520 at 35,522 (June 22, 2010) [hereinafter Primary SO₂ NAAQS].

²³⁴ Primary SO₂ NAAQS at 35,521, 35,524.

²³⁵ EPA, Fact Sheet: Revisions to the Primary National Ambient Air Quality Standard, Monitoring Network, and Data Reporting Requirements for Sulfur Dioxide, 2, *available at* <http://www.epa.gov/air/sulfurdioxide/pdfs/20100602fs.pdf>.

²³⁶ Primary SO₂ NAAQS at 35,520.

²³⁷ EPA, Ammonia Acute Exposure Guideline Levels, <http://www.epa.gov/opptintr/aegl/pubs/results88.htm>.

²³⁸ See discussion of EPA's NAEMS data, *supra* Section V.B.1.iii.b.

CAFOs. In addition, because much of the existing research on ambient ammonia levels near CAFOs involves time-averaged data, EPA should consider the fact that spikes in ambient ammonia levels have not been thoroughly documented when establishing an adequate margin of safety in its standards.

EPA's SO₂ rulemaking also sets a precedent for regulating pollutants whose health effects are significant, but not ubiquitous. The new standard resulted from a challenge to the agency's 1997 decision not to modify the SO₂ NAAQS, despite its finding that short-term exposures below the previous standards posed a health threat to asthmatics. EPA had determined that a more stringent five-minute health standard was not necessary when it considered SO₂ "from a national perspective," finding that the health threat was not adequately ubiquitous and the likelihood that a susceptible individual would suffer adverse health effects was low.²³⁹ The American Lung Association and the Environmental Defense Fund successfully challenged this decision in the District of Columbia Circuit, which held that "nothing in the Final Decision explains away the possibility that 'localized,' 'site-specific,' or even 'infrequent' events might nevertheless create a public health problem, particularly since, in some sense, all pollution is local and site-specific...."²⁴⁰

EPA should apply this analysis to ammonia, which primarily affects rural residents near CAFOs. While ambient ammonia levels likely do not pose a significant health threat in most urban areas, and therefore may not affect the majority of the public, the D.C. Circuit made clear that even localized, site-specific, and infrequent ambient air pollution may create a public health risk that meets the standard in § 108 and therefore requires CAA regulation. In its final SO₂ rule, EPA further pointed out that "in selecting primary standards that include an adequate margin of safety, the Administrator is seeking not only to prevent pollution levels that have been demonstrated to be harmful but also to prevent lower pollutant levels that may pose an unacceptable risk of harm, even if the risk is not precisely identified as to nature or degree."²⁴¹ EPA should adopt the same cautious approach regulating ambient ammonia, the adverse health effects of which have been documented but which has not been rigorously studied by EPA, particularly in combination with other air pollutants. And as with the SO₂ rule, EPA should require ambient air monitoring for ammonia in areas with an "increased coincidence of people and [ammonia] emissions."²⁴²

²³⁹ *Id.* at 35,522.

²⁴⁰ *Id.* at 35,523, quoting *American Lung Ass'n v. EPA*, 134 F.3d 388, 392 (D.C. Cir. 1998).

²⁴¹ *Id.* at 35,521.

²⁴² *Id.*

VII. EPA SHOULD CONSIDER ENVIRONMENTAL JUSTICE CONCERNS WHEN DECIDING WHETHER TO REGULATE AMMONIA

EPA must consider environmental justice concerns regarding ammonia emissions when deciding whether to regulate ammonia. Executive Order 12,898 directs all agencies to consider environmental justice concerns during the decision-making process.²⁴³ EPA has acted to effectively implement this Order through its recently issued Interim Guidance regarding environmental justice.²⁴⁴ The Interim Guidance sets out two primary environmental justice concerns for the agency: ensuring fair treatment and enabling meaningful involvement of those impacted by EPA actions.²⁴⁵ Fair treatment requires that “no group of people should bear a disproportionate burden of harms and risks,” including the “negative environmental consequences” of governmental policies.²⁴⁶ To achieve meaningful involvement by impacted communities, those potentially affected must have an appropriate role in decisions that may affect their environment or health.²⁴⁷ Simply permitting input does not satisfy this obligation; EPA decision-makers have committed to actively “seek out and facilitate the involvement of those potentially affected.”²⁴⁸

EPA’s decision whether to regulate ammonia from factory farms involves an environmental justice concern, because certain communities are disproportionately impacted by the pollution from these operations and have been excluded from meaningful participation in decisions regarding their siting and regulation. In addition, EPA’s response to this petition will constitute an “action that involves an environmental justice concern,” because it “present[s] opportunities to address existing disproportionate impacts on minority, low-income, or indigenous populations that are addressable through the action.”²⁴⁹ CAFO ammonia pollution implicates nearly all of the primary factors EPA’s Interim Guidance identifies as consideration factors for decision-making processes: (1) proximity and exposure to environmental hazards, (2) susceptible populations, (3) unique exposure pathways, (4) multiple and cumulative effects, and (5) ability to participate in the decision-making process.²⁵⁰ As discussed throughout this petition, CAFOs are the largest source of ammonia emissions in the US, and thus the environmental justice analysis EPA conducts when reviewing this petition must address communities impacted by CAFO air pollution.

²⁴³ Exec. Order 12,898 (1994).

²⁴⁴ EPA, EPA’s Action Development Process: Interim Guidance on Considering Environmental Justice During the Development of an Action (July 2010).

²⁴⁵ *Id.* at 3.

²⁴⁶ *Id.*

²⁴⁷ *Id.*

²⁴⁸ *Id.*

²⁴⁹ *Id.* at 6.

²⁵⁰ *Id.* at 7-8.

Peer-reviewed sociological studies have shown that CAFOs are disproportionately located in communities with low socioeconomic status and frequently in predominantly African-American communities. One 2006 study of seventh and eighth grade students in North Carolina found an association between economic disadvantage and “proximity to the nearest hog CAFO and with strength of the odor.”²⁵¹ The study found two other troubling correlations: populations already vulnerable to asthma and other illnesses are more likely to be exposed to CAFO emissions such as ammonia,²⁵² and schools with a high non-white population and a low socioeconomic status were more likely than other schools to have hog CAFOs nearby.²⁵³ A 2011 study of 16 North Carolina communities concluded that in general, “[i]ndustrial hog operations in North Carolina are disproportionately located in low-income communities of color.”²⁵⁴

Another study looked at placement and expansion of large hog CAFOs in 17 states, including three states where large-scale production had been rapidly expanding: North Carolina, Iowa, and Minnesota. In these three states, the researchers found disproportionate siting and expansion of large hog CAFOs in African-American communities in the 1980s and 1990s, and concluded that as hog production shifts from small-scale to large-scale, racial inequity in CAFO siting intensifies.²⁵⁵

Yet another study investigated hog CAFO siting in Mississippi, looking both state-wide and specifically in the counties with hog production, to determine whether hog CAFOs sited disproportionately in areas with higher poverty or higher percentages of African-American residents.²⁵⁶ The study found three times as many hog CAFOs in (1) high African-American, low poverty and (2) high poverty, low African-American communities as compared to a control.²⁵⁷

EPA should consider the combined effects of the increasing geographic concentration of CAFOs, the adverse effect CAFOs have on nearby property values, and the disproportionate siting of CAFOs in low-income and minority communities when assessing the environmental justice impact of CAFO ammonia emissions. These factors exacerbate existing inequity, as low-income residents who already have the lowest mobility will become even less able to escape pollution as property values decline and more CAFOs move into an area. Citizens who live close to CAFOs and who breathe ammonia pollution every day frequently will not have the

²⁵¹ Maria C. Mirabelli, Steve Wing, Stephen W. Marshall & Timothy C. Wilcosky, *Race, Poverty, and Potential Exposure of Middle-School Students to Air-Emissions from Confined Swine Feeding Operations* 114 *Env'tl. Health Persp.* 591, 593 (April 2006).

²⁵² *Id.* at 591, 594.

²⁵³ *Id.* at 595.

²⁵⁴ Schinasi, *supra* note 109 at 7.

²⁵⁵ Jeremy Arney, Janice E. Johnston, & Paul B. Stretesky, *Environmental Inequity: An Analysis of Large-Scale Hog Operations in 17 States, 1982-1997* 68 *Rural Sociology* 231, 244 (2003).

²⁵⁶ Sacoby M. Wilson, et al., *Environmental Injustice and the Mississippi Hog Industry*, 110 *Env't'l Health Perspectives* 2 (April 2002).

²⁵⁷ *Id.* at 199.

means to uproot their lives and families to move to a safer, less polluted community – nor should they have to.

The petitioners request that EPA recognize the environmental justice issues that underlie regulation of ammonia and make environmental justice a primary goal when determining whether to regulate it. This consideration should involve targeted outreach to communities near large or numerous CAFOs and active solicitation of public input from these stakeholders. EPA should base its determination of what constitutes protective regulation and fair treatment on the most adversely impacted communities and the most susceptible individuals, rather than simply assessing average ammonia concentrations in all rural communities.

VIII. EPA HAS A DUTY TO MAKE AN ENDANGERMENT FINDING AND REGULATE AMMONIA

In *Massachusetts v. EPA*,²⁵⁸ the Supreme Court clarified EPA’s obligations to make endangerment findings for air pollutants under the CAA.²⁵⁹ In its discussion of EPA’s discretion to determine, in the administrator’s judgment, whether to make an endangerment finding for an air pollutant, the Court noted that “the use of the word “judgment” is not a roving license to ignore the statutory text.” Rather, the exercise of this judgment “must relate to whether an air pollutant ‘cause[s], or contribute[s] to, air pollution which may reasonably be anticipated to endanger public health or welfare.’”²⁶⁰ When EPA issues its response to a petition for rulemaking “its reasons for action or inaction must conform to the [CAA],” and EPA can only decline to act if it either finds that no endangerment exists or “provides some reasonable explanation as to why it cannot or will not exercise its discretion” to make an endangerment finding one way or another.²⁶¹

Ammonia is a known and extensively researched toxin, for which “sufficient information exists to make an endangerment finding.”²⁶² EPA and other federal agencies, as well as numerous peer-reviewed studies, have extensively documented ammonia’s adverse health and welfare impacts, and EPA lacks the requisite “scientific uncertainty...so profound that it precludes EPA from making a reasoned judgment”²⁶³ as to endangerment. Similarly, EPA lacks reasonable grounds on which to make a finding that ammonia does not endanger public health or

²⁵⁸ *Massachusetts v. EPA*, 549 U.S. 497 (2007).

²⁵⁹ Though the Court addressed the endangerment language in § 202(a), emissions standards for new motor vehicles, the language is substantially identical to the endangerment language in § 108(a). The Court’s reasoning relied on the plain language of the statute, and therefore also applies to endangerment findings under § 108(a). EPA has not interpreted these provisions as having significantly different meanings, and thus the “normal rule of statutory construction that identical words used in different parts of the same act are intended to have the same meaning” applies. *Gustafson v. Alloyd Co., Inc.*, 513 U.S. 561, 569 (1995) (internal quotation marks and citations omitted).

²⁶⁰ *Mass v. EPA* at 532-33.

²⁶¹ *Id.* at 533.

²⁶² *Id.* at 534.

²⁶³ *Id.*

welfare. Consequently, a failure to initiate a rulemaking that proposes an endangerment finding for ammonia would be arbitrary and capricious.

If EPA makes an endangerment finding for ammonia, the finding will trigger a mandatory duty to list ammonia as a criteria pollutant. CAA § 108(a)(1) requires that the EPA Administrator “shall” list pollutants that meet the previously discussed requirements of (A) and (B), and “for which air quality criteria had not been issued before December 31, 1970, but for which [s]he plans to issue air quality criteria under this section.” CAA § 108(a)(1)(C). In *NRDC v. Train*, the Second Circuit clarified that the latter provision of part (C) does not give EPA discretion to choose not to list a pollutant for which it made an endangerment finding because it has no “plans” to do so.²⁶⁴ Rather, the court found conclusively that “[o]nce the conditions of §§ 108(a)(1)(A) and (B) have been met, the listing of [the pollutant] and the issuance of air quality standards for [the pollutant] become mandatory.”²⁶⁵

Because ammonia meets the legal requirements above, the petitioners request that EPA review the scientific data regarding ammonia, make an endangerment finding, and determine that it must list ammonia as a criteria pollutant. The petitioners further request that EPA then establish both primary and secondary NAAQS for ammonia under §109 of the CAA for the protection of public health and public welfare with an adequate margin of safety.

IX. CONCLUSION

This petition requests that EPA regulate ammonia as a criteria pollutant under the CAA. Ammonia meets all of the legal requirements for listing as a criteria pollutant, and numerous peer-reviewed studies show that ambient ammonia endangers both public health and public welfare. CAA § 109(d)(1) gives EPA authority to re-evaluate the criteria and promulgate new standards for pollutants at its discretion, provided it completes a thorough review every five years, and the petitioners respectfully request that EPA undertake a review of ammonia without delay. An unreasonable delay responding to this petition, an arbitrary and capricious denial of this petition, or a scientifically unsubstantiated failure to make an endangerment finding will subject EPA to judicial review under Administrative Procedure Act²⁶⁶ (APA) § 706(1), APA § 706(2)(A), or CAA § 304(a)(2).

²⁶⁴ *NRDC v. Train*, 545 F.2d 320 (2nd Cir. 1976).

²⁶⁵ *Id.* at 328. EPA recently questioned this 34-year old precedent in its *Advanced Notice of Proposed Rulemaking: Regulating Greenhouse Gas Emissions Under the Clean Air Act*, 73 Fed. Reg. 44,354 at 44,477 FN 229 (2008). Although EPA has postulated that the subsequent establishment of *Chevron* deference could lead to a different outcome than under the *NRDC* court, that court used an analysis that would now clearly fall under *Chevron* “step 1,” in finding that the statute’s plain language, structure, and legislative history “leave no room for interpretation” and impose a mandatory duty on EPA. *NRDC v. Train*, 545 F.2d at 328. Thus, an effort to overturn this precedent would likely fail.

²⁶⁶ Administrative Procedure Act, 5 U.S.C. §§ 551-559; 701-706 (2006).

As previously discussed, the petitioners assert that the scientific record on ammonia's threat to public health gives rise to an affirmative duty by EPA to make an endangerment finding and regulate ambient ammonia. Thus, the petitioners will deem a failure by EPA to make such a finding and initiate a rulemaking to designate ammonia as a criteria pollutant a "failure...to perform any act or duty...which is not discretionary," which is subject to judicial review under the citizen suit provision of the CAA. CAA § 304(a)(2).

The petitioners request that EPA respond to this petition in a timely manner by making an endangerment finding for ammonia and determining that it will regulate ammonia under CAA §§108 and 109 for the protection of public health and public welfare. The APA provides the petitioners with the right to petition EPA for a rulemaking to list ammonia as a criteria pollutant, and also obligates EPA to respond "with due regard for the convenience and necessity of the parties" and "within a reasonable time...proceed to conclude a matter presented to it." APA § 555(b). CAFOs have escaped regulation for their air emissions for decades, and rural citizens whose health have been and continue to be harmed by airborne ammonia require swift action by EPA. Therefore, in determining what constitutes a reasonable time for response to this petition, the petitioners urge EPA to consider that "human health and welfare are at stake."²⁶⁷

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²⁶⁷ See *In Re. American Rivers & Idaho Rivers United, Petitioners*, 372 F.3d 413, 418 (D.C. Cir. 2004).

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