Polk County
Large-Scale Livestock (Swine) Facility Study Group Report

Submitted to the Polk County Environmental Services Committee for Consideration in April of 2020

Study Group Participants

MEMBERS

Listed alphabetically by last name.

- **Tonya Eichelt –** *Polk County Community Services Division Director*
- **Brian Kaczmarski –** *Polk County Health Department Director*
- **Robert Kazmierski –** *Polk County Environmental Services Director*
- **Jason Kjeseth-** *Polk County Zoning Administrator*
- **Eric Wojchik** – *Polk County Land and Water Resources Conservation Planner*

OTHER STAFF MEMBERS AND THEIR ROLES

Listed alphabetically by last name.

a. **Katelin Anderson**-Worked on creating maps and survey response spreadsheet
b. **Tim Anderson**- Provided recommendations, helped facilitate stakeholder meetings, tallied surveys and worked on analysis, attended DATCP hearing in Spooner
c. **Lori Bodenner**- Sent proper notices to Towns and newspaper for all meetings
d. **Dane Christenson**- Worked on map development and attended conservation seminar
e. **Scott Geddes**- Engineer on team, map development, provided guidance on Land and Water Resources Ordinances.
f. **Elizabeth Haas**- Attended stakeholder meetings
g. **Brian Hobbs**- Provided staff and committee with information on what public health would regulate in regards to CAFO's, attended staff meeting on 1/21/2020. (See below)
h. **Vince Netherland**- Attended stakeholder meetings, relayed supervisor's comments to appropriate staff, coordinated committee and county board meetings.
i. **Nick Osborne**- Provided guidance on the initial process, and what Burnett County was going through regarding CAFO's, attended the livestock siting public hearing in Spooner
j. **Tim Ritten**-Created original outline on the process, reviewed scientific studies provided by members of the public, and attended DATCP hearing in Spooner

OTHER CONTRIBUTORS

Listed alphabetically by last name.

a. **Supervisor Amy Middleton** – Supplied the information and outline in Addendum B and Addendum C
b. **Supervisor Brad Olson** – Supplied the information in Addendum A

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Livestock Facility study group-Scope of work

Background

The Polk County Board of Supervisors enacted Resolution 33-19 imposing a temporary moratorium on the creation and expansion of large scale swine livestock facilities with 1000 animal units or more. (Appendix A) This moratorium did not apply to other types of livestock, or to the expansion of structures/ buildings. This moratorium was extended at the February 20, 2020 meeting of the Polk County Board of Supervisors via Resolution 03-20 for an additional six months. (Appendix B) The WI DNR, via the EPA and WPDES permitting, regulates all types of large-scale livestock facilities with or exceeding 1,000 animal units (CAFOs). Therefore, some research revolved around all types of livestock facilities with 1,000 animal units or more.

PURPOSE

The purpose of this moratorium is to allow Polk County the time to investigate the impacts of large-scale swine livestock facilities on groundwater, surface water, air quality, and public health/safety. Staff within this study group, the Environmental Services Division, and Public Health Department reviewed numerous articles and reports, attended seminars, public hearings, and had experts speak on these impacts. Ultimately, the County wants to find out whether an amendment of existing ordinances, creation a livestock facilities licensing ordinance, or another type of ordinance that would be applicable in all unincorporated areas of Polk County is required to protect the public health/safety, air, water resources, and land within Polk County.

PROCESS

Following the adoption of the large-scale swine livestock facility moratorium by the Polk County Board of Supervisors, staff in the Environmental Services Division and Public Health Department confirmed the expectations of staff during the moratorium with the Environmental Services Committee. The livestock facility study group was created to collect and organize the data received into this report. The County has strived to provide public comment opportunities and be transparent throughout each phase of this process. This report serves as the primary communication from the livestock facility study group and other Environmental Services Division staff to the Environmental Services Committee and Polk County Board of Supervisors.

- **Development of the Study Group**
  The study group consists of five county staff members who were selected because of their expertise in each of the key impact topics and roles at Polk County.

- **Gathering and Synthesizing Research-Based Information**
  The study group members received scientific studies from members of the public, surrounding counties, UW-Extension, and several universities. This information helped identify the eight main impacts further explored in this report. The County also had presenters from the

DNR and DATCP. The study group collected ordinances and reports from other counties and municipalities pertaining to large livestock facilities.

- **Public Involvement**
  The study group discussed the information received with the Environmental Services Committee and many members of the public during several meetings. The study group also organized individual stakeholder meetings for agricultural producers, local officials, and concerned citizens. During these stakeholder meetings, staff presented some possible ordinance conditions developed by the committee, and had interactive discussions and feedback with members from the public. A survey was also conducted at this time to receive feedback for the committee and study group. (Appendix C & D)

- **Presentation of Information**
  The study group compiled this report with the information collected thru research, presentations, and stakeholder meetings. The report will be presented to the public and Environmental Services Committee. The Committee will then decide if any new ordinances or amendments are necessary to protect Polk County residents from any potential impacts.
  The committee did not want staff recommendations included in this report.

TIMELINE

- April 17, 2019- Meeting in Burnett County with proposed large scale swine livestock facility consultant. It was discussed that smaller facilities may be located in Polk County during this meeting.
- August 20, 2019- Committee of the Whole Meeting where County Board received presentations from DNR & DATCP officials. County Board meeting followed and lots of literature was provided during public comments.
- August 28, 2019- First time moratorium was before the Environmental Services committee. Staff was directed to start looking into the research materials provided at the County Board meeting.
- September 15, 2019- Attended DATCP Public Hearing in Spooner on proposed ATCP 51 amendments.
- October 15, 2019- resolution passed by Polk County Board of Supervisors to establish a six month moratorium on large scale swine livestock facilities. This moratorium had a clause that would allow an extension for up to 6 months.
- December 11, 2019- Brian Kaczmarski presented the public health risks/concerns before the Committee.
- January 21, 2020- Held stakeholder meetings for agricultural producers, local officials, and concerned citizens.
- February 20, 2020- Moratorium on large scale swine facilities was extended. Resolution 03-20 also prohibited large-scale swine facilities with 1000 animal units or more within the shoreland areas.

- March 11, 2020- Environmental Services Committee recommended the proposed amended shoreland ordinance to the County Board with text prohibiting large-scale swine facilities in all shoreland areas.
- April 29, 202 – Environmental Services Committee reviewed first draft of CAFO report and provided guidance for updating with Addendums A, B, and C

DEFINITIONS

Animal Unit:(AU) measure equivalencies between animal types as established by s. NR 243.05, Wis. Adm. Code and the CAFO WPDES permit program. For example, 1,000 beef cattle, 715 milking cows or 200,000 chickens are each equivalent to 1,000 AU. Livestock/poultry feeding operations with 1,000 or more AU are Concentrated Animal Feeding Operations (CAFO) and need a Wisconsin Pollutant Discharge Elimination System (WPDES) permit to operate.

CAFO: A Wisconsin animal feeding operation with 1,000 animal units or more is a large Concentrated Animal Feeding Operation (CAFO). The DNR may designate a smaller-scale animal feeding operation (fewer than 1,000 animal units) as a CAFO if it has pollutant discharges to navigable waters or contaminates a well.

Committee: Environmental Services Committee

DATCP: Wisconsin Department of Agriculture, Trade and Consumer Protection

DNR: Wisconsin Department of Natural Resources

EPA: Environmental Protection Agency

High Capacity Well: a well that has the capacity to withdraw more than 100,000 gallons per day, or a well that, together with all other wells on the same property, has a capacity of more than 100,000 gallons per day.

HUC-12 surface watershed: a digital watershed boundary dataset. The dataset is comprised of nested regions, called hydrologic units (HUs), which delineate progressively smaller watersheds. Each hydrologic unit has a code assigned to it, called a hydrologic unit code (HUC). A HUC is a series of two-digit groupings of numbers that describe a hydrologic unit scale, plus where it fits in the larger hydrologic unit framework. While ranging in size and typical HUC-12 will be 25-50 square miles.

Impaired water: Under section 303(d) of the Clean Water Act, states, territories, and authorized tribes, collectively referred to in the act as "states," are required to develop lists of impaired waters. These are waters for which technology-based regulations and other required controls are not stringent enough to meet the water quality standards set by states. The law requires that states establish priority rankings for waters on the lists and develop Total Maximum Daily Loads (TMDLs) for these waters. A TMDL includes a calculation of the maximum amount of a pollutant that can be present in a waterbody and still meet water quality standards.

Livestock: means any of the following:

- swine

LWRD: Polk County Land and Water Resources Department

Pathogen: a bacterium, virus, or other microorganism that can cause disease.

Polk County Board of Supervisors ("County Board"): citizen members elected to represent fifteen districts within Polk County to set policy and programming as a function of County government.

USDA-FSA: United States Department of Agriculture - Farm Service Agency

USDA-NRCS: United States Department of Agriculture - Natural Resources Conservation Service

UW-Extension: Local connection to the University of Wisconsin system

Watershed: An area of land that separates waters flowing to different rivers or basins.

Water quality management area (WQMA): the area within 1,000 feet from the ordinary high water mark of navigable waters that consist of a lake, pond or flowage, except that, for a navigable water that is a glacial pothole lake, the term means the area within 1,000 feet from the high water mark of the lake; the area within 300 feet from the ordinary high water mark of navigable waters that consist of a river or stream; and a site that is susceptible to groundwater contamination, or that has the potential to be a direct conduit for contamination to reach groundwater.

WPDES- Wisconsin Pollutant Discharge Elimination System permits ensure farms use proper planning, nutrient management, and structure/system construction to protect Wisconsin waters. These permits apply only to water quality protection. They do not give the DNR authority to address air, odor, traffic, lighting, land use nor any of the social concerns people may have about large farms.

Key Findings

Groundwater

Polk County is generally rural with an estimated 2018 population of 44,380. All residents rely on quality ground water for drinking, cooking, bathing, irrigating and watering livestock. Groundwater quantity and quality has been an emerging concern in recent years due to media attention of groundwater contamination in eastern and southwest Wisconsin. Susceptibility, capability, and vulnerability are three similar terms used to describe this risk. Groundwater is susceptible to contamination when there is either a direct or indirect conduit from the land surface to the groundwater. The average cost of a new well in Polk County is $10,000, and the cost of a reverse osmosis system can be several thousands of dollars. According to the Polk County Land and Water Resources Management Plan for 2020-2029 groundwater emerged as the most important natural resource in Polk County.

According to WI Department of Natural Resources, Polk County has approximately 11,074 private wells reported and 76 high capacity water withdrawal locations. Of the 76 high capacity locations, 72 are groundwater sourced and 4 are surface water sourced. The total use volume of the high capacity well locations exceeded 3.1 billion gallons in 2018.

The Wisconsin Department of Natural Resources, US Geological Society, Wisconsin Geological and Natural History Survey, and University of Wisconsin-Madison developed a Groundwater Contamination Susceptibility Model in the mid 1980's to estimate the susceptibility of groundwater based on particular natural resource characteristics. The natural resource characteristics that affect groundwater susceptibility include:

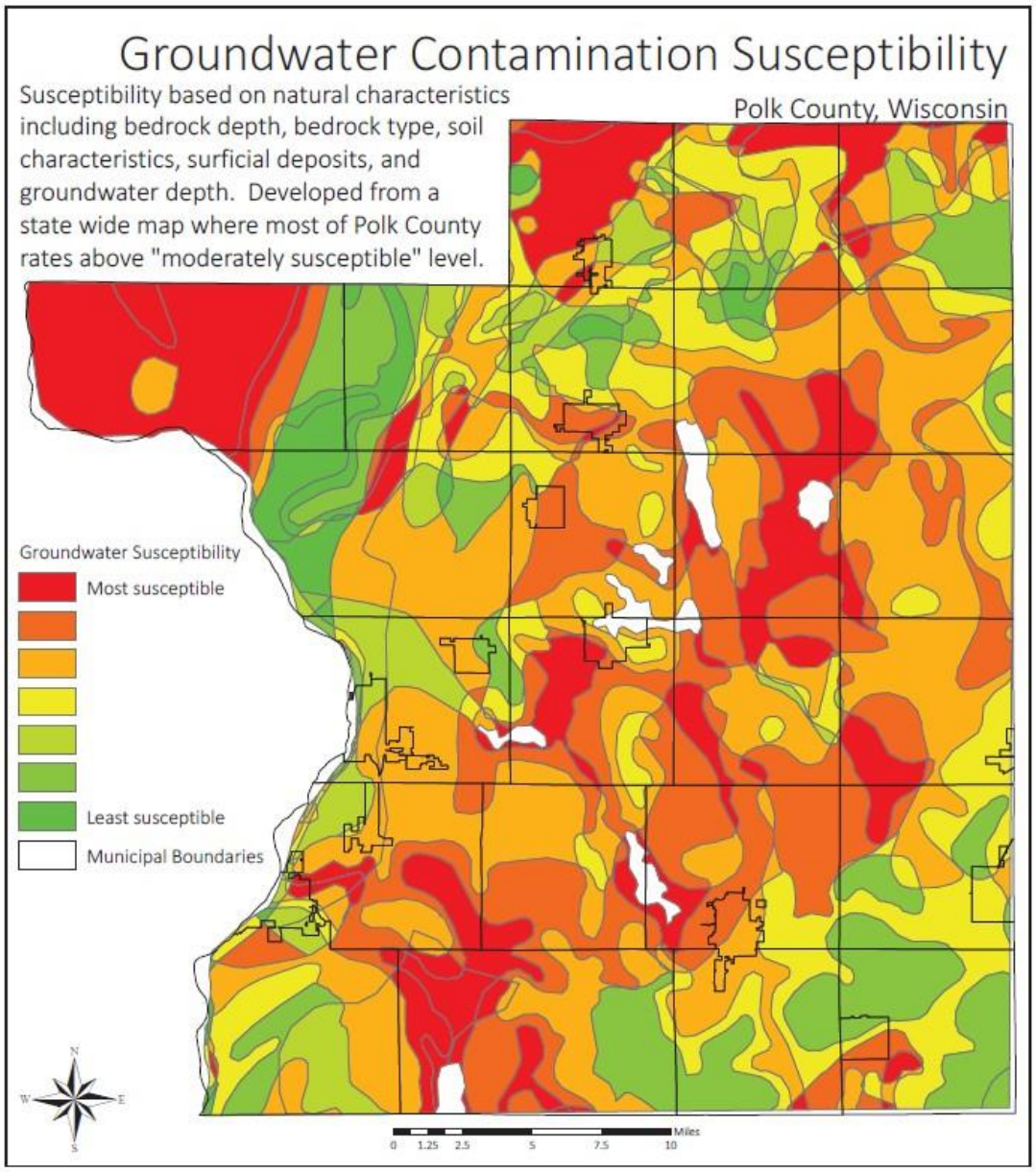
- Type of bedrock, depth to bedrock, depth to water table, soil characteristics, and characteristics of surficial deposits (Source: Groundwater Contamination Susceptibility in Wisconsin)
- Activities on the land can contaminate groundwater; most contaminants originate on the land surface and seep down to the groundwater. In some cases groundwater contamination can become contaminated from natural causes such as radioactivity in the form of radium, which is present in certain types of rocks. (Source: Groundwater Contamination Susceptibility in Wisconsin)
- Groundwater can be contaminated by farms through runoff from land application of manure, leaching from manure that has been improperly spread on land, or through leaks or breaks in storage or containment units. (Source: Understanding Animal Feeding Operations and Their Impact on Communities).

Areas that are most vulnerable to contamination are areas above fractured karst bedrock where there are thin soils, soils with limited capacity of using and retaining excess nutrient loads or capturing bacteria, sandy soils with little organic matter, or a combination of those factors. The result of this analysis is a groundwater susceptibility map for the State of Wisconsin which shows that the majority of Polk County has contamination susceptibility numerical scores above the "moderately susceptible" level.

Map 1: Polk County Groundwater Contamination Susceptibility Map provides an illustration for evaluating areas of the county for their level of susceptibility to pollution from land surface activities. Different land uses impact groundwater differently. This map does not reflect land use or impact of land use. Note that this map does not do any of the following:

- Predict areas that will be (or are) contaminated
- Predict areas that are safe from contamination

Map 1: Polk County Groundwater Contamination Susceptibility



The University of Wisconsin-Stevens Point maintains an interactive Well Water Quality Viewer summarizing private well water quality data collected by state agencies and voluntarily submitted by homeowners over the past 25 years. Health standards exist for arsenic, lead, manganese, and

nitrate. Six percent of Polk County wells exceeded the standard for lead, 10% for manganese, and 4% for nitrate. Additionally, twenty-one percent, or 46 wells, tested positive for coliform whereas no wells tested positive for E. coli (sample size 42). The table below shows the common parameters and results from all these samples.

Table 1: Polk County Summary Statistics, University of Wisconsin Well Water Quality Viewer, February 2020 Updated Statistics Available Online: https://gissrv3.uwsp.edu/webapps/gwc/pri_wells/

Parameter	Total Samples	Minimum	Median	Average	Maximum	Exceeds Health Standard
Alkalinity (mg/L CaCO3)	219	28	130	131	357	
Arsenic (ppb)	728	ND[1]	ND	1	84	2% > 10
Atrazine (ppb)	104	ND	ND	0.1	2	
Chloride (mg/L)	219	ND	2.5	6.1	99.8	
Conductivity (umhos/cm)	219	67	250	267	759	
Copper (mg/L)	30	ND	0.039	0.157	1.52	
Iron (mg/L	25	ND	0.059	1.214	17.782	
Lead (ppb)	32	ND	ND	3	20	6% > 15
Manganese (ppb)	32	ND	2	90	1183	10% >300
Nitrate (mg/L as N)	2,488	ND	1	2.3	38.6	4% > 10
pH	219	6.29	7.82	7.71	8.46	
Saturation Index	195	-3.3	-0.1	-0.2	0.9	
Total Hardness	194	4	128	133	368	

[1] ND = no detect

Wisconsin DNR maintains a database of Remediation and Redevelopment sites that have contaminated groundwater and or soil. As of November 2018, there are twenty-eight open status sites in Polk County. Fifteen sites are environmental repair sites, twelve are leaking underground storage sites, and one is a spill site. An additional seventy-two sites in the county have continuing obligations. Once a site is contaminated, the site itself can be cleaned up even though it may be costly, but groundwater is much more difficult to clean up. Contaminated groundwater can move laterally and eventually enter surface water, such as rivers or streams.

Nitrates

Natural levels of nitrate in Wisconsin's groundwater are generally less than 1 mg/L. Amounts greater than this indicate that land use in an area is impacting groundwater. Sources of nitrate include agricultural fertilizers, lawn fertilizers, septic system drain fields, and other nitrogen sources such as animal manures, bio- solids, industrial sludge, etc.

Nitrate levels higher than 10 mg/L, regardless of their source, are considered unsafe for infants and women who are pregnant or trying to conceive. The Wisconsin Department of Health Services recommends when nitrate levels are high, water should not be given to babies less than

6 months old or used to make infant formula. In addition, everyone avoid long-term use of the water for drinking and preparing foods.

In Wisconsin, approximately 9% of wells tested indicate levels of nitrate higher than 10 mg/L. In Polk County, approximately 4% of wells exceed state and federal limits for safe drinking water with levels of 10 mg/L or more of nitrate (Figure 1). In general, higher nitrates are located in the southwestern and west central area of Polk County (Figure 2). Nitrate levels between 1 and 10 mg/L have been found in 96% of the wells tested. (Source: Wisconsin Well Water Viewer). Well tests do not directly indicate the exact source of nitrates.

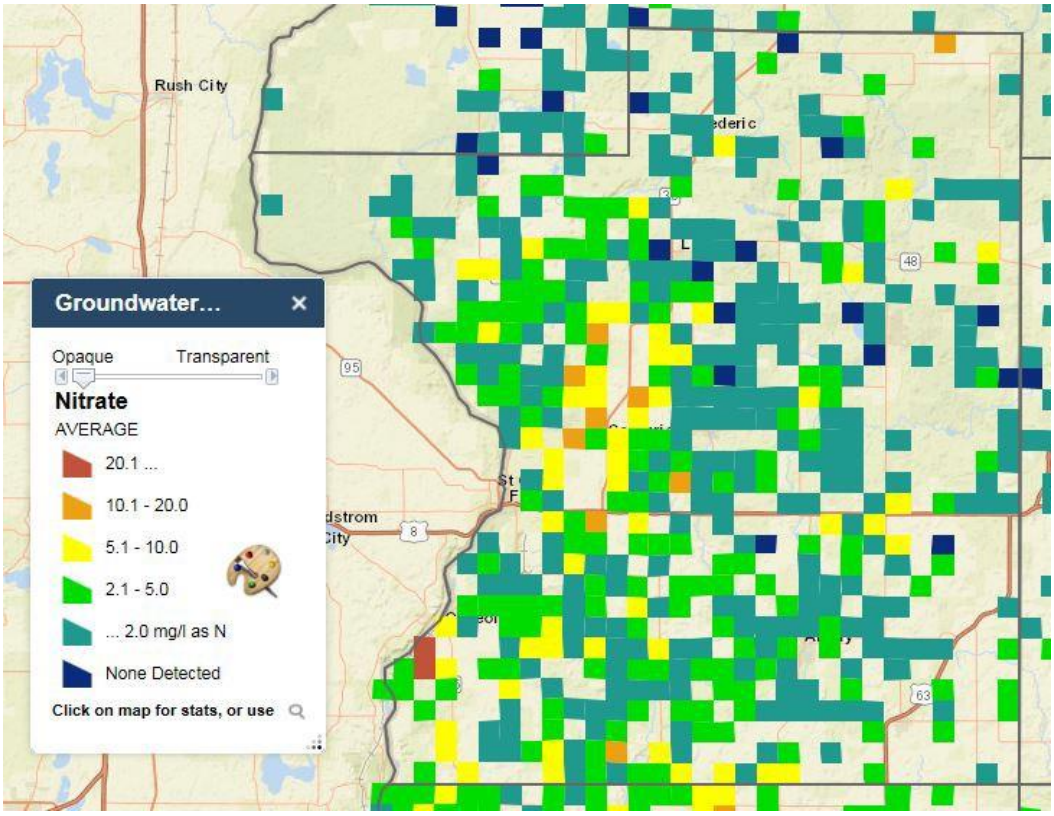
Elevated nitrates in drinking water can be especially harmful to infants, leading to blue baby syndrome and possible death. Nitrates oxidize iron in hemoglobin in red blood cells to methemoglobin. Most people convert methemoglobin back to hemoglobin fairly quickly, but infants do not convert back as fast. This hinders the ability of the infant's blood to carry oxygen, leading to a blue or purple appearance in affected infants. However, infants are not the only one who can be affected by excess nitrates in water. Low blood oxygen in adults can lead to birth defects, miscarriages, and poor general health. (Source: Understanding Concentrated Animal Feeding Operations and Their Impact on Communities).

According to a 2019 Polk County groundwater study, within the Balsam Lake watershed 15% of wells exceeded the public health standard of 10 mg\L. According to the Center for Watershed Science and Education at the University of Wisconsin-Stevens Point, nitrate levels between 1 and 10 mg/L are evidence of land use impacts and often indicate susceptibility of the groundwater to other possible contaminants. The percentage of wells testing positive for nitrates indicates that the County's groundwater is susceptible to nitrates and other contaminants and should be monitored further.

Additionally, recent studies have implicated nitrate exposure as a possible risk factor associated with lymphoma, gastric cancer, hypertension, thyroid disorder and birth defects (Source: Environmental Human Health & Safety Risk to Water Quality, Air Quality, Soil Quality, and Natural Areas from Concentrated Animal Feeding Operations).

NITRATE LEVELS POLK COUNTY GROUNDWATER (2019)

Figure 1: Nitrate Levels from All Sources in Polk County by Section. *Sections that are blank do not have sufficient data to calculate an average.*



Source: Wisconsin Well Water Viewer. ***https://gissrv3.uwsp.edu/webapps/gwc/pri_wells/***

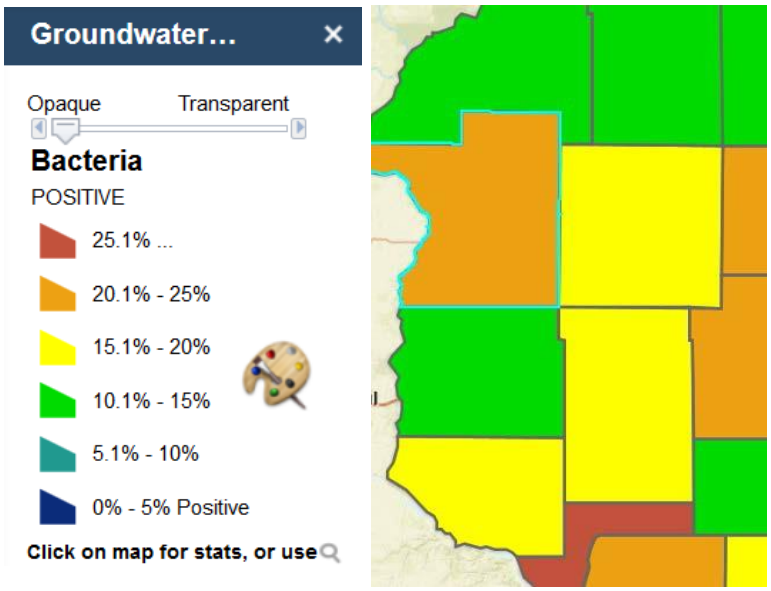
Coliform Bacteria & E. coli

Twenty percent of Polk County wells are, on average, contaminated with coliform bacteria.

A coliform bacteria test measures a well's ability to produce clean water. It is not necessarily an indication of groundwater quality; because it doesn't distinguish between well construction susceptibility, plumbing contamination, and groundwater susceptibility. Coliform bacteria indicates potential sanitary defect that could allow pathogens to enter a well water supply and cause illness.

On average, approximately 15% of wells in Wisconsin test positive for coliform bacteria and approximately 1%-2% of wells are contaminated with *E. coli*. E.coli is a specific type of bacteria that indicates contamination by either human or animal waste. Carriers of E. coli can include: cattle, other ruminants such as sheep, goats, deer which are considered more significant carriers, while other mammals (such as pigs, horses, rabbits, dogs, and cats) and birds (such as chickens and turkeys) have been found infected (source: World Health Organization[7]). While there are types of *E. coli* that are harmless, other types can make people sick. In Polk County, approximately 21% of wells have tested positive for coliform bacteria and no wells have detected *E. coli* in 42 samples in 2019 (Figure 2). (Source: Wisconsin Well Water Viewer).

Figure 2: Coliform Bacteria in Wisconsin Counties



Statistics Report

(1 of 1) Clear

BACTERIA (Positive/Negative) for Polk County

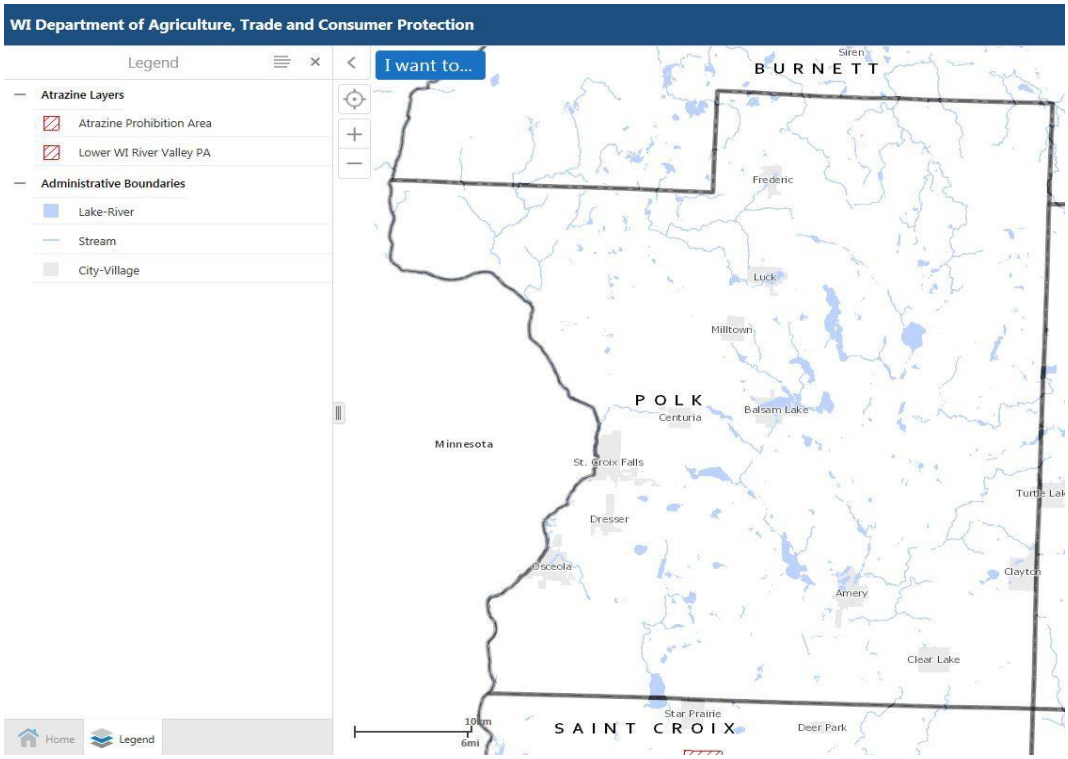
Bacteria	Number	Percent
Coliform Positive	46	21%
Coliform Negative	173	79%
Total:	219	
E. coli Positive	0	0%
E. coli Negative	42	100%
Total:	42	

Source: Wisconsin Well Water Viewer. ***https://gissrv3.uwsp.edu/webapps/gwc/pri_wells/***

Agricultural Pesticides *(Atrazine Type Pesticides)*

Atrazine type pesticides have been linked to causing developmental delays in children and some types of cancers. According to the Wisconsin Department of Agriculture, Trade, and Consumer Protection, "if people drink water for many years that contains 3 parts per billion or more of atrazine or its metabolites, they may develop cardiovascular, reproductive, or other health problems." If atrazine is found to be at the 3 parts per billion level, the use of atrazine in that area may be prohibited. Figure 3 shows the atrazine prohibition areas in Polk County. There are currently no atrazine prohibition areas in Polk County.

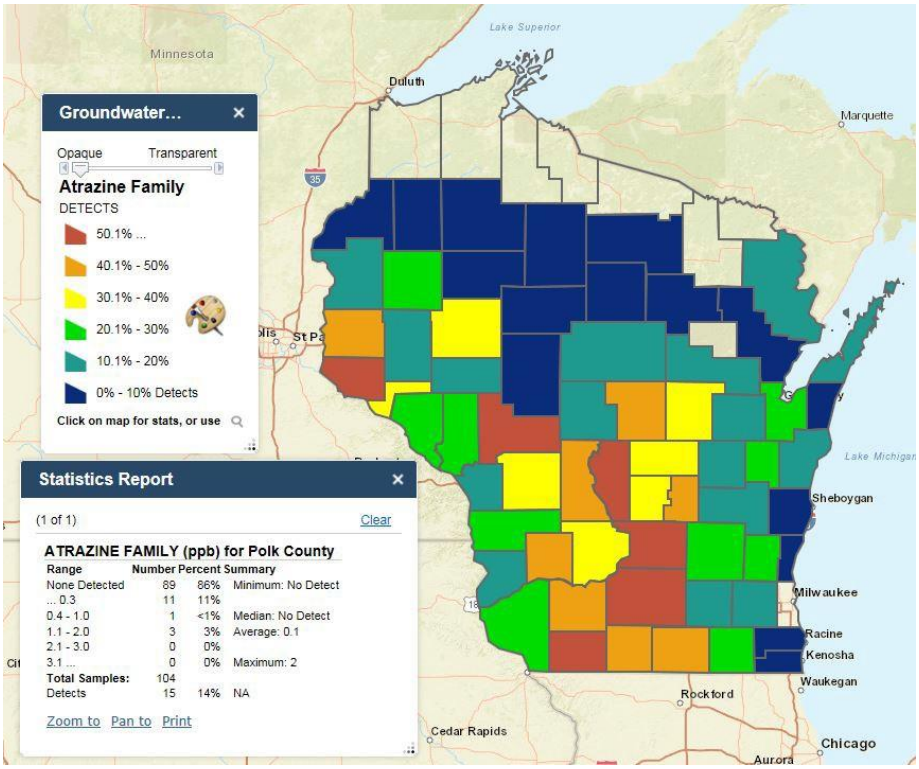
Figure 3: Atrazine Prohibition Area in Polk County



Source: Wisconsin Department of Agriculture, Trade, and Consumer Protection https://datcpgis.wi.gov/maps/?viewer=pa

It is estimated that approximately 22.9% of wells in Wisconsin contain atrazine (Source: Wisconsin Groundwater Quality: Agricultural Chemicals in Wisconsin's Groundwater). In Polk County, well testing data indicates that between 10.1-20% of wells have tested positive for atrazine type pesticides (Figure 4).

Figure 4: Atrazine Type Pesticides in Wisconsin



Source: Wisconsin Well Water Viewer. ***https://gissrv3.uwsp.edu/webapps/gwc/pri_wells/***

Pathogens

Animals, such as rodents, insects and birds can carry pathogens, which can cause disease. When groundwater is contaminated by pathogenic organisms, a serious threat to drinking water can occur. Pathogens survive longer in groundwater than surface water due to lower temperatures and protection from the sun. Even if the contamination appears to be a single episode, viruses could become attached to sediment near groundwater and continue to leach slowly into groundwater._ Table 2 shows some of the pathogens found in animal manure and other sources.

Table 2: Select Pathogens Found in Animal Manure and Other Sources

Pathogen	Disease	Symptoms	Sources (per CDC)
Bacillus anthracis	Anthrax	Skin sores, headache, fever, chills, nausea, vomiting	Domestic and wild animals such as: cattle, sheep, goats, antelope and deer
Escherichia coli	Colibacilosis, Coliform mastitis-metris	Diarrhea, abdominal gas	Cattle, other ruminants such as sheep, goats, deer which are considered more significant carriers, while other mammals (such as pigs, horses, rabbits, dogs, and cats) and birds (such as chickens and turkeys) have been found infected
Leptospira pomona	Leptospirosis	Abdominal pain, muscle pain, vomiting, fever	Many different kinds of wild and domestic animals, including but not limited to: cattle, pigs, horses, dogs, rodents, wild animals.
Listeria monocytogenes	Listerosis	Fever, fatigue, nausea, vomiting, diarrhea	Bacteria is found in soil and water. Humans and animals can become infected by consuming food or water with the bacteria in it.
Salmonella species	Salmonellosis	Abdominal pain, diarrhea, nausea, chills, fever, headache	The bacteria lives in the intestines of people and almost all warm and cold-blooded animals. Transmitted when food is contaminated or through direct contact with animals or their environment.
Clostirdum tetani	Tetanus	Violent muscle spasms, lockjaw, difficulty breathing	Tetanus bacteria spores are found everywhere in the environment, Including soil, dust and animal feces.
Histoplasma capsulatum	Histoplasmosis	Fever, chills, muscle ache, cough rash, joint pain, and stiffness	This fungus is found in soil that contains large amounts of bat or bird droppings.

Microsporum and *Trichophyton*	Ringworm	Itching, rash	Can be transmitted from contaminated surfaces, infected people, or infected animals, like dogs, cats, cows, goats, pigs, and horses.
Giardia lamblia	Giardiasis	Diarrhea, abdominal pain, abdominal gas, nausea, vomiting, fever	This parasite can infect people or animals, including, but not limited to cats, dogs, cattle, deer, and beavers.
Cryptosporidium species	Cryptosporidosis	Diarrhea, dehydration, weakness, abdominal cramping	All mammals, especially young animals, can get cryptosporidiosis. Calves and lambs are most often affected. Birds, fish and rabbits can also be infected. Dogs, cats and horses rarely get this disease.

Antibiotics

Antibiotics have been used in human and animal medicine for over 50 years. Antibiotics are commonly administered to livestock in the United States to prevent, control, and treat bacterial infections. Over the past several years, the FDA has taken important steps toward fundamental change in how medically important antibiotics can be legally used in feed or water for food-producing animals. The agency has moved to eliminate the use of such drugs for production purposes (i.e., growth promotion and feed efficiency) and bring their remaining therapeutic uses in feed and water under the supervision of licensed veterinarians – changes that are critical to ensure these drugs are used judiciously and only when appropriate for specific animal health purposes. The Veterinary Feed Directive (VFD) final rule is an important part of the agency's overall strategy to ensure the judicious use of medically important antimicrobials in food-producing animals.

Effective January 1, 2017, stricter federal rules regulate how medically important antibiotics—medications that are important for treating human disease—can be administered to animals in feed and drinking water. Among the provisions, the U.S. Food and Drug Administration requires veterinary oversight whenever such antibiotics are administered to any food animal species via feed or water, even if the animals are not intended for food production. From pet rabbits and pigs, to backyard poultry, to large livestock farms, the same restrictions apply. All medically important antibiotics to be used in feed or water for food animal species require a Veterinary Feed Directive (VFD-is a written statement issued by a licensed veterinarian that authorizes the use of a drug in or on an animal feed) or a prescription.

1) Antibiotics must be used responsibly

   The driving force for the initial VFD rule in 1996 and the recent revisions was improving drug availability for the benefit of animal health and welfare, and, in turn, food safety. The increasing threat of antibiotic resistance (antimicrobial resistance) to both human and animal health compelled the FDA to take action by removing production uses of medically important antibiotics and implementing greater veterinary oversight by transitioning over-the-counter (OTC) antibiotics to VFD or prescription status. Any antibiotic use can contribute to antibiotic resistance, so it is important to avoid unnecessary or inappropriate uses of antibiotics. The use of medically important antibiotics in livestock is one factor that can contribute to increasing resistance, and the 2017 VFD revisions (published in June 2015) aim to put responsibility for their use into the hands of veterinarians, who are trained to understand not only when these medications are needed, but also what is the appropriate drug, dose, duration, and administration method to resolve infection and protect animal health and our food supply. The expertise of the veterinarian is critical to ensuring the responsible use of antibiotics in animals.

2) The VFD protects animals and people

   The FDA and drug manufacturers agreed to remove production uses (i.e., growth promotion, feed efficiency) for antibiotics that are medically important, and to require veterinary oversight for use of these antibiotics in feed (requires a VFD) or water (requires a prescription). Under the direction of a veterinarian, the responsible and appropriate administration of antibiotics reduces the opportunity for resistance to develop, and helps preserve our supply of effective antibiotics for situations of true need to protect animal and human health. While the change may be challenging, the end result will be more responsible antibiotic use that will benefit human and animal health.
3) Antibiotics will still be available

Veterinarians are committed to ensuring that animal health and welfare needs are met, and that needed medications be available and administered in a timely manner for treating, controlling, or preventing animal disease. Animals will still receive antibiotics when there is a clear indication of their need. Food producers are able to work with veterinarians to ensure that animals have the care and medication they need, when they need it.

Air Quality

When looking at air quality, the large scale livestock study group considered gases, odor, and particulates. CAFOs have the potential to release large quantities of gases, odors, and particulates due to the decomposition of the large amount of waste generated by the animals in CAFOs. CAFO emission rates can vary depending on weather conditions, daily activities, time of day, and seasons. Due to this variability, monitoring air quality can be difficult and costly.

The pollutants commonly connected with livestock operations are ammonia and hydrogen sulfide. In Wisconsin, neither pollutant has risen to the level to be considered a health hazard. While exposure to these pollutants can cause or exacerbate respiratory conditions such as asthmas, eye irritation, difficulty breathing, wheezing, sore throat, chest tightness, nausea, and bronchitis and allergic reactions. The potential mental health impacts of air pollution greatly varies due to concentration and length of exposure. (Source: Green County Livestock Operations Study Group Report).

Hydrogen sulfide is a very toxic gas when present in hog barns at high concentrations (> 500 ppm by volume), which is an unusual event. Short-term exposures at this level have caused death in swine confinement workers. However, published studies do not support the idea that hydrogen sulfide causes respiratory disease in persons working in hog confinement facilities under ordinary conditions, where levels are in the range of 2-3 ppm or less. (Source: Health Effects from Breathing Air Near CAFOs for Cattle or Hogs, Von Essen and Auvermann) According to Dr Frank Mitloehner, hydrogen sulfide can potentially be an issue in confined spaces, like shafts and while raking livestock beds, and workers need to wear a respirators.

CAFOs also emit ammonia, which is rapidly absorbed by the upper airways in the body. This can cause severe coughing and mucous build-up. Particulate matter may lead to more severe health consequences for those exposed by their occupation. Farm workers can develop acute and chronic bronchitis, chronic obstructive airways disease, and interstitial lung disease. Repeated exposure to CAFO emissions can increase the likelihood of respiratory diseases. (Source: Nalboh) In free-style barns like in WI and elsewhere on farms, ammonia is not likely an issue. Studies have shown that ammonia levels on farming operations have not risen to the level of a health concern. (Source: Dr. Mitloehner).

Aside from the possibility of lowering air quality in the areas around them, all livestock facilities also emit greenhouse gases, and therefore contribute to climate change. Globally, livestock operations are responsible for approximately 14.5% of greenhouse gas production (Source: Food and Agriculture Organization of the United Nations) and over 4% of U.S. greenhouse gas emissions (source: EPA). While carbon dioxide is often considered the primary greenhouse gas of concern, manure emits methane and nitrous oxide which are 28 and 265 times more potent as greenhouse gases than carbon dioxide, respectively. The EPA attributes manure management as the fourth leading source of nitrous oxide emissions and the fifth leading source of methane

emissions (Source: EPA) However, methane is considered recycled carbon, meaning plants soak up carbon dioxide from the atmosphere, and then those plants are eaten by livestock, who then emit it back into the atmosphere. Methane stays in the atmosphere for 10 years, then is destroyed and becomes carbon dioxide again.

Table 1 shows a number of pollutants typically found in air surrounding CAFOs, along with the related health risks. Research over the last decades has shown that microbial exposures, especially endotoxin exposure, are related to deleterious respiratory health effects, of which cross-shift lung function decline and accelerated decline over time are the most pronounced effects. (Environ Health Perspect. 2007 Feb;115(2):298-302. Epub 2006 Nov 14. (Nat'l Institute of Health)

Table 1.

CAFO Emissions	**Source**	**Health Risks**
Ammonia	Formed when microbes decompose undigested organic nitrogen compounds in manure.	Respiratory irritant, chemical burns to the respiratory tract, skin, and eyes, severe cough, chronic lung disease.
Hydrogen Sulfide	Anaerobic bacterial decomposition of protein and other sulfur containing organic matter.	Inflammation of the moist membranes of eye and respiratory tract, olfactory neuron loss, death.
Methane	Microbial degradation of organic matter under anaerobic conditions.	No health risks. Is a greenhouse gas and contributes to climate change.
Particulate Matter	Feed, bedding materials, dry manure, unpaved soil surfaces, animal dander, poultry feathers.	Chronic bronchitis, chronic respiratory symptoms, declines in lung function, organic dust toxic syndrome.

Source: Understanding Concentrated Animal Feeding Operations and Their Impact on Communities by the National Association of Local Boards of Health (2010).

According to the Wisconsin DNR, the Wisconsin Pollutant Discharge Elimination System (WPDES) for CAFOs does not address odor. Odor management scoring is a required part of the Wisconsin Livestock Siting Standards, but Polk County has not adopted a livestock siting ordinance. Additionally, odor from land-spreading of manure typically does not expose neighbors to hazardous levels of ammonia or hydrogen sulfide, and bad odor has not typically been enough to constitute a nuisance in most counties.

There are a number of identified best management practices to mitigate air pollution and reduce odor; these practices were developed by the Wisconsin Agricultural Waste Air Emissions Advisory Group, convened by the Wisconsin DNR. These practices are designed to reduce emissions of hazardous air pollutants from livestock operations. Many of these practices are included in the odor standards of the Livestock Siting Law.

Land Use

As stewards of the land, farmers use conservation practices, such as no- till, cover crops, crop rotation, [managed grazing,] nutrient management, and integrated pest management. As depicted by Map 1, all of the groundwater in Polk County is susceptible to contamination to varying degrees. While livestock operations are not the only potential contamination sources, the study group concentrated on their impacts in this report. Soil has the capability of filtering different substances from water as it percolates through the soil. However, some soils are more suitable for land spreading of manure depending on the soil type, slope of land, time of year/precipitation, and many other factors. Soil limitations generally cannot be overcome without major soil reclamation, special design or expensive installation procedures. Therefore, the County and producers should recognize that land spreading is not suitable in all areas without risk to groundwater contamination.

There is a land capability classification system of grouping soils primarily on the basis of their capability to produce common cultivated crops and pasture plants without deteriorating over a long period of time. Eight classes exist in this system and all have a significance in suitability for certain activities.

Class I *(1)* soils have slight limitations that restrict their use.

Class II *(2)* soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.

Class III *(3)* soils have severe limitations that reduce the choice of plants or require special conservation practices, or both.

Class IV *(4)* soils have very severe limitations that restrict the choice of plants or require very careful management, or both.

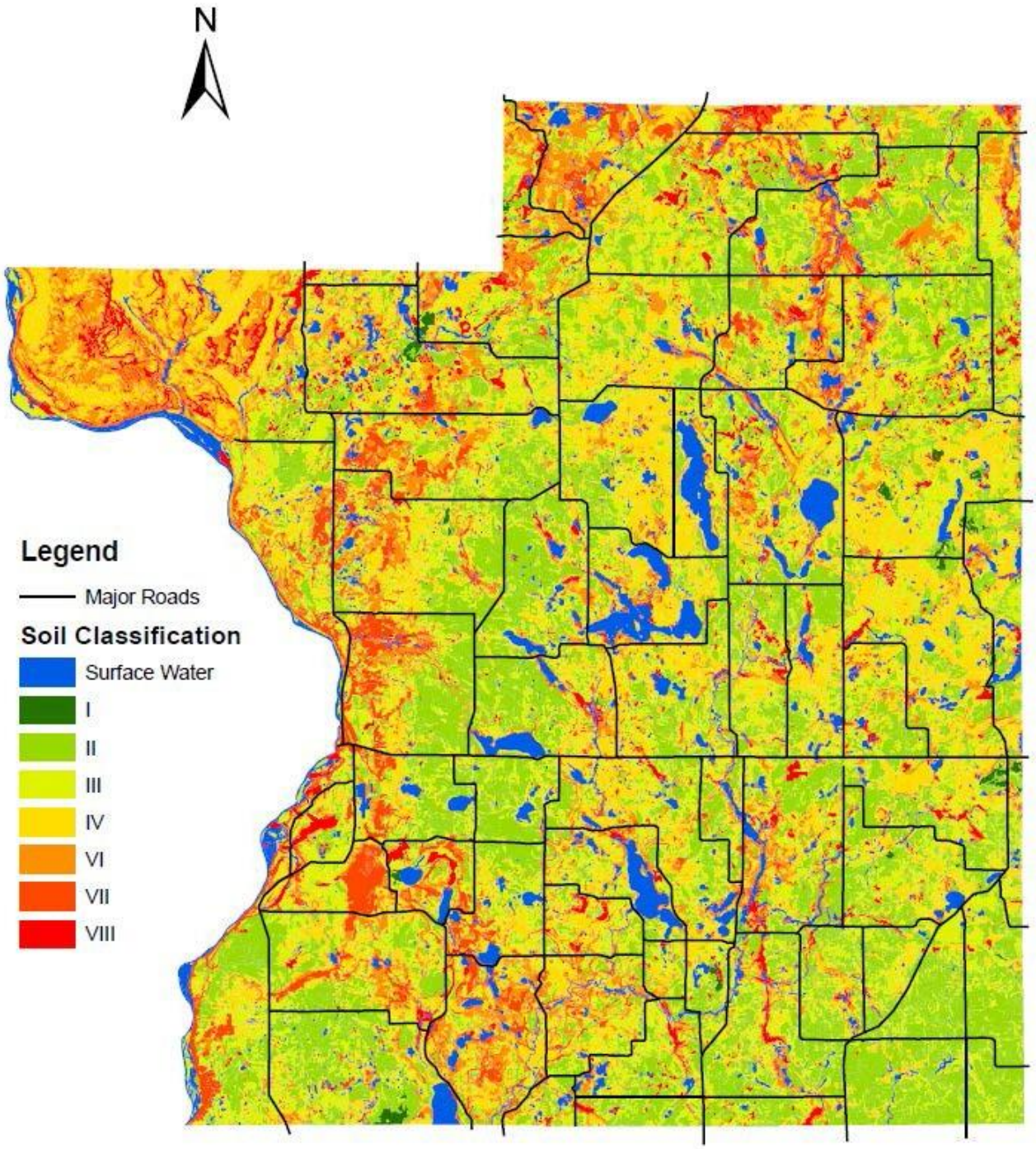
Class V *(5)* soils have little or no hazard of erosion but have other limitations, impractical to remove, that limit their use mainly to pasture, range, forestland, or wildlife food and cover. (No class V in Polk County)

Class VI *(6)* soils have severe limitations that make them generally unsuited to cultivation and that limit their use mainly to pasture, range, forestland, or wildlife food and cover.

Class VII *(7)* soils have very severe limitations that make them unsuited to cultivation and that restrict their use mainly to grazing, forestland, or wildlife.

Class VIII *(8)* soils and miscellaneous areas have limitations that preclude their use for commercial plant production and limit their use to recreation, wildlife, or water supply or for esthetic purposes.

Map 2: Soil Capability Classification in Polk County



Surface Water

Polk County has an abundance of surface water resources with 437 lakes and 365 miles of streams and rivers distributed throughout the county. Polk County's lakes range widely in size and depth, with the largest being Balsam Lake (1,901 acres), Bone Lake (1,667 acres), and Lake Wapogasset (1,189 acres) and the deepest being Lower Pine Lake (102 feet). Homes and cottages ring most large lakes, and the shores of many smaller lakes have become targets

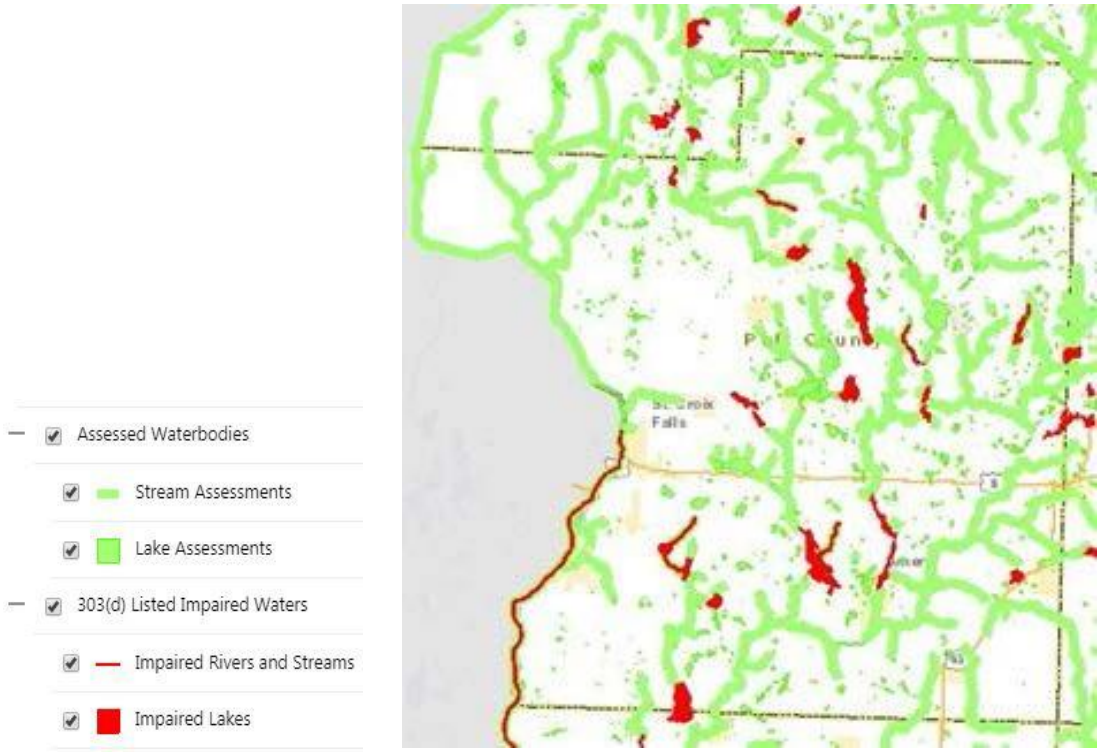
for residential development. The St. Croix River flows along the county's western border receiving water from most of Polk County. Wetlands dot the surface of the landscape.

The lakes, rivers, and wetlands of the county are impacted by upland land use practices in the watersheds that drain to them. Most of the pollutants that enter water resources are carried in runoff from many diffuse, or nonpoint sources. The major pollutants of concern are sediment (carried from areas with bare soil such as crop fields and construction sites) and phosphorus (both attached to soil particles and dissolved in water from fertilizers and animal waste). Many Polk County lakes are shallow and as a result are more susceptible to internal loading, or the release of nutrients from lakebed sediments. Excessive nutrient concentrations of nitrogen or phosphorus, can lead to eutrophication and make water uninhabitable to fish or indigenous aquatic life. Nutrient over-enrichment causes algae blooms which can cause a spiral of environmental problems to an aquatic system.

Polk County's surface water resource impairments.

- Approximately 37 water bodies are listed as "impaired" (Source WI DNR Impaired Waters list 2020)
- Polk County's phosphorus load is 160,976 lbs./yr. – the largest of any county in the St. Croix River Basin (Source Lake St. Croix TMDL Plan)
- When a stream is listed on the Impaired Waters list it means that it does not meet the surface water quality standards of the federal Clean Water Act as documented by the U.S. Environmental Protection Agency.

Map 3: Impaired Water List Streams in Polk County



Source: Wisconsin Surface Water Data Viewer. https://dnrmaps.wi.gov/H5/?Viewer=SWDV

Current Policies and Programs

Polk County entities are currently addressing groundwater/surface water and public health protection in a number of ways. These include:

Well Abandonment. The Polk County Land and Water Resources Department promotes proper well decommission, targeting non-compliant wells and wells that are no longer used. Financial assistance is offered for this practice through the Land and Water Resources Department.

Well Testing and Monitoring. The Polk County Health Department provide water testing kits as well as educational materials on water testing.

Well Database. The Wisconsin Department of Natural Resources maintains a database of all well-drilling records. This information is available by request or by contacting the local Water Supply Specialist.

Groundwater Study. The Polk County Land and Water Resources Department has identified potential priority watersheds within the county to begin groundwater studies associated with the goals and objectives listed in the 2020-2029 Land and Water Resource Management Plan.

Farmer Led Watersheds. The Polk County Land and Water Resources Department continues to assist with farmer led watershed groups in Polk County to promote additional outreach and adoption of locally identified best management practices.

Best Management Practices. The Polk County Land and Water Resources Department provides education and incentives for various best management practices, including nutrient management and manure storage facilities. The Department provides education, cost-sharing dollars, grant funding, and technical assistance to assist farmers and landowners in adopting best management practices, installing conservation practices, and complying with existing regulations, such as:

- Funding for cost-sharing barnyard runoff control projects;
- Funding for cost-sharing well decommissioning projects;
- Staff for project implementation and implementation of livestock ordinances;
- Promotion of no-till;
- Promotion of cover cropping;
- Education on nutrient management planning;
- Water and sediment control basins (WASCBs)
- Prescribed grazing.

Nutrient Management Plans. The Polk County Land and Water Resources Department promotes the creation and proper implementation of nutrient management plans, by providing training, cost- sharing, and technical assistance to agricultural producers. Key elements included in a nutrient management plan are:

- Soil tests to determine soil supplied nutrients,
- an inventory of on-farm nutrient sources like manure and legumes,
- identification of current on-farm conservation practices and areas sensitive to erosion,

- nutrient loss and areas with application restrictions,
- a cropping plan that reduces soil and nutrient loss, and
- a recommendation for commercial fertilizer applications that takes into account other aspects of the plan and meets the needs of the crop while reducing impact to surface and groundwater resources.

Currently, based on agricultural producer submitted reporting, at least 10% of Polk County cropland is under a nutrient management plan.

Manure Storage Ordinance. The Polk County Land and Water Resources Department enforces the county's Manure and Water Quality Management ordinance. This ordinance protects the surface water and groundwater of Polk County by assuring the implementation of applicable performance standards for manure storage, animal waste handling, and disposal.

Ordinances. The Polk County Land and Water Resources Department administers ordinances to address common land management practices that pose a risk to surface water resources. The Polk County Manure and Water Quality ordinance sets standards to be met when handling or storing livestock waste. The Stormwater and Erosion Control Ordinance requires design procedures and preventative measures to reduce the runoff risk of construction sites to surface water.

Phosphorus Management. The Polk County Land and Water Resources Department works with several agricultural producers and lake associations or districts in Polk County to identify and implement practices that improve soil health and water quality.

Response to Contamination Spills. Polk County Land and Water Resources Department works with DNR to handle these in a timely manner. All spills over 250 gallons are required to be reported to WI DNR.

Permitting. Livestock waste storage facilities construction and closure must be permitted and meet all permit requirements (i.e. Nutrient Management Planning and compliance with NRCS waste storage standards 313 and transfer system standards 634). If applicable certain construction sites are also permitted for Stormwater and Erosion Control.

Septic Maintenance. Polk County Zoning Department ensures that septic systems are inspected and maintained every three years.

Zoning. The Polk County Land Information Department administers the Polk County Shoreland Protection Zoning Ordinance which limits impervious surfaces, filling/grading activities, and vegetation removal around all lakes, rivers, and streams in Polk County. A lot of the activities conducted under this ordinance require runoff mitigation especially if the amount of impervious surface on the lot exceeds 15%.

Uniform Dwelling Code. Local building inspectors monitor and enforce erosion control plans on new construction sites during their routine inspections.

Addition of Staff. The Wisconsin DNR are adding staff to increase outreach and compliance surrounding large livestock facilities.

Right-to-Farm Laws

With all of the potential environmental and public health effects from CAFOs, community members and health officials often resort to taking legal action against these industrial animal farms. However, there are some protections for farms in place that can make lawsuits hard to navigate. Right-to-farm laws were created to address conflicts between farmers and non-farming neighbors. They seek to override common laws of nuisance, which forbid people to use their property in ways that are harmful to others, and protect farmers from unreasonable controls on farming. All 50 states have some form of right-to-farm laws, but most only offer legal protections to farms if they meet certain specifications. Generally, they must be in compliance with all environmental regulations, be properly run, and be present in a region first before suburban developments, often a year before the plaintiff moves to that area. These right-to-farm laws were originally created in the late 1970s and early 1980s to protect family farms from suburban sprawl, at a time when large industrial farms were not the norm. Wisconsin has a right-to-farm law which prohibits a county from prohibiting CAFOs. However, there are certain regulations and permitting options for a county to consider in order to regulate farming within their communities.

Addendums

Addendum B: Additional Information by Supervisor Olson

At the April 29, 2020 and May 13, 2020 Environmental Services Committee meetings, Supervisor Olson provided comments, additional information and suggested changes to the initial CAFO report. He also invited Dr Frank Mitloehner to provide his expertise on CAFO impact. Below is a summary of this information:

Article #1: Fate and Transport of Zoonotic Bacterial, Viral, and Parasitic Pathogens During Swine Manure Treatment, Storage, and Land Application.

Article discusses the difference in survival rates of viruses and bacteria in the various methods for manure storage and treatment. In general, the more treatments the manure went through, the higher the reduction in survival of viruses and bacteria. However, the reduction in microbial organisms by each treatment varies widely and so does the amount in the manure pre-treatment.

Source: Council for Agricultural Science and Technology (CAST). 2008. *Fate and Transport of Zoonotic Bacterial, Viral, and Parasitic Pathogens During Swine Manure Treatment, Storage, and Land Application.* Special Publication 29. CAST, Ames, Iowa. Sponsored by the Pork Checkoff. Copies of *Fate and Transport of Zoonotic Bacterial, Viral, and Parasitic Pathogens During Swine Manure Treatment, Storage, and Land Application* are available from CAST at *www.cast-science.org.*

Article #2: Worker Health and Safety in Concentrated Animal Feeding Operations

The article discusses the different chemicals of concern on a CAFO, such as hydrogen sulfide, ammonia, volatile organic compounds (VOC's), endotoxins, and particulate matter. When exposed to high concentrations of these compounds, workers can experience respiratory inflammation and obstruction, asthma, pneumonia, bronchitis, damage to the central nervous system and cardiovascular complications. Most of the air emissions that are harmful to human health arise from the handling of feed, movement of animals on manure, and the storage and removal of manure. CAFO air pollutants include hydrogen sulfide, ammonia, volatile organic compounds, particulate matter, and endotoxins. Because the composition of these emissions differs according to farm layouts, region, and species of animals housed, there is a large variability in emission rates and farm practices across all types of livestock operations. This variability makes it difficult to identify and correct implicated agricultural practices for the purpose of improving the health of farm worker.

Source: Frank Mitloehner and M.S. Calvo: *Worker Health and Safety in Concentrated Animal Feeding Operations*, Journal of Agriculture, Safety and Health 14(2): pg 163-87; April, 2008; can be found at:
https://www.researchgate.net/publication/51400593_Worker_Health_and_Safety_in_Concentrated_Animal_Feeding_Operations

Article #3: Risks from Large-Scale Livestock Operations in Iowa

Discusses the impacts from large-scale livestock facilities in terms of ecological impact on groundwater, surface water, and wildlife. Also reviews the public health implications, including ammonia, hydrogen sulfide, carbon dioxide, methane, odor, and nitrates.

Conclusions of the article are that inside swine buildings, exposure to gases and dusts may result in high levels of respiratory disease in workers. Levels of these substances in outdoor air are significantly lower than those associated with occupational illness and not likely high enough to cause disease alone. CAFOs are not considered to be an apparent public health hazard. (See Appendix F)

Article #4: The Association between Proximity to Animal Feeding Operations and Community Health: A Systematic Review

This article evaluated the studies reporting the association between animal feeding operations and the health of individuals living near animal feeding operations but not actively engaged in livestock production. Based on the magnitude and the consistency of associations observed there was little compelling evidence for a consistent strong association between clinical measures of disease and proximity to AFOs. However, the body of work is small in this area and based on epidemiological studies which have greater potential for bias.
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0009530

Article #5:

This article is an update of Article #4. The updated review found that there is sufficient evidence to conclude that communities living in proximity to goat production are at increased risk of Q fever. The association between MRSA colonization and proximity is unclear, mainly due to a lack of replication. The conclusions about associations with other outcomes, especially those related to upper and lower respiratory disease, are unchanged from the prior review.
https://www.researchgate.net/publication/316348147_Updated_systematic_review_Associations_between_proximity_to_animal_feeding_operations_and_health_of_individuals_in_nearby_communities

Article #6:

Slide presentation from the Pork Checkoff, describing and summarizing the results of various research studies that show no causal effect between CAFO's/livestock emissions and public health. (See Appendix F)

Article #7: Are You Ready for the truth About Antibiotic Use? The Truth Is In.

Online article describing issues and changes that have occurred around antibiotic usage in livestock production.
https://exploreanimalhealth.org/are-you-ready-for-the-truth-about-antibiotic-use-the-evidence-is-in/

Article #8: Setting the Record Straight: Animal Ag Has Nothing to Do With COVID-19

Online article outlining the reasons why animal agriculture is not connected with the COVID-19 outbreak.
https://www.drovers.com/article/setting-record-straight-animal-ag-has-nothing-do-covid-19?fbclid=IwAR3tYs0YJmPUZvZdKZCKu_d9YzJRMa2a0gzenjWAQe93VL0jID0D-Opzq98

Article #9: National Pork Board – Sustainability

Series of information from the National Pork Board on the sustainability of the pork industry. More information can be found at: https://www.pork.org/environment/

Article #10: National Pork Board

National Pork Board Answers Your Questions

Q. Do new hog facilities affect property values?

A. New, large livestock facilities were strongly associated with higher nearby residential property values in an independent, scientific study paid for by the Minnesota Legislature and conducted by the researchers at the University of Minnesota. The study, the largest of its kind to date, looked at actual sales prices of 292 rural residential properties located near livestock facilities larger than 500 animal units (1,250 head of hogs). The study showed a mean price increase of 6.6% for a rural residential property near a new feeding operation of this size or greater.

Q. What are the perceived negative economic effects of pork production?

A. Concerns typically involve quality-of-life issues like aesthetics, comfort, health, property values and housing development. In some areas of the country, citizen groups have organized to oppose new or expanded pork production facilities. The resulting debates, often emotional and contentious, have caused severe rifts between neighbors and among people in the community.

There is very little evidence, however, to support fears of deterioration in quality-of-life for communities that include pork production operations. For example, communities in North Carolina have experienced rapid growth in pork production at the same time tourism has increased. Rural economies grounded in pork production and related businesses have been able to thrive, increasing property values. Small communities can attract and keep young families by supporting growth of the pork industry because it provides opportunities for new businesses and good paying jobs.

As pork production methods become more familiar to the public, concerns should diminish. Responsibly managed pork operations promote economic prosperity, particularly in rural areas that may have few economic development opportunities.

Q. What are the economic benefits of pork production?

A. Pork production is a vital and growing part of the nation's economy and the industry's economic impact on rural America is especially significant. Annual farm sales usually exceed $11 billion, with the retail value of pork totaling about $30 billion. When the economic impact of wages and profits spent in other sectors is included, pork producers are responsible for generating more than $66 billion in total domestic economic activity.

Through direct, indirect, and induced effects, the pork industry supports over 600,000 jobs and adds nearly $27.4 billion of value to production inputs. Efficient production methods keep consumer pork prices in the United States among the lowest in the world. The pork industry also produces non-food items used in medicines, and cleaning agents. Pharmaceutical by-products include insulin,

various hormones, materials used to dress wounds and burns, and replacement heart valves. Industrial by-products include cleaners, adhesives, proteins, dyes, insulation, crayons, chalk, lubricants, and leather.

The versatility of pork products makes production an appealing and potentially profitable business. The number of hogs produced in the United States now exceeds 93 million and the number of farms with hogs is more than 157,000 (USDA, December 1996).

Pork producers contribute to the economic viability of rural communities by supporting service and retail businesses from the farm gate to main street. As many small towns experience a gradual loss in population and tax base, areas that rely on pork production and related businesses often benefit from greater tax revenues, increased per capita incomes, stronger employment rates, and other factors that build economically stable communities.

Q. Are pork producers good stewards of natural resources?

A. Producers are very much aware that environmental conservation is in the long-term interest of their own business, the pork industry, and the nation. As residents of rural America, producers are committed to protecting their local environment for their families, neighbors, and communities. In short, good stewardship means good business.

As stewards of the environment, pork producers have funded and applied innovative research and technology programs to improve the quality of life in rural areas, prevent the degradation of environmental resources, and reduce odors and other potential problems associated with their operations.

The first edition of the "Guide to Environmental Quality in Pork Production," has been cited by the U.S. Environmental Protection Agency as a model for use by other agricultural industries. Pork producers have worked with state and federal regulatory agencies to develop and present environmental workshops for more than 5,000 producers throughout the nation. These cooperative and educational efforts have improved operational efficiency while protecting the environment for future generations.

Q. What are the differences between commercial and manure fertilizer?

A. The most environmentally significant difference between hog manure and commercial fertilizer is the relative concentration of nitrogen, phosphorus, and potassium compounds. Hog manure typically averages about 15 lb/ton of nitrogen, 30 lb/ton of phosphorus, and 10 lb/ton potassium. In liquid systems, the nutrient values are slightly higher 30 lb/1,000 gal of nitrogen, 32 lb/1,000 gal of phosphorus, and 25 lb/1,000 gal of potassium. In either liquid or nonliquid systems, other nutrients and minerals which are essential for optimum plant growth are present in trace amounts. In commercial fertilizers, concentrations of nitrogen, phosphorus, and potassium can be much higher in concentration per ton. Furthermore, the trace elements and minerals found in manure are not present in commercial fertilizers.

While manure is a good source of a wide range of nutrients, it can be bulky, wet, heavy, and difficult to manage. Producers must regularly collect, store, handle, treat, transport, and apply manure, and each of these activities requires a substantial investment of time, equipment, and

money. The primary advantage of commercial fertilizer is that it is easier to handle because it comes in ready-to-use form.

Some producers are researching ways to convert manure to low concentration, commercially-available fertilizers that will not overburden the earth's nutrient cycling processes–particularly aquatic nutrient cycles. This research is ultimately intended to convert manure into another value-added product. While promising, it has not yet resulted in a product that is economically feasible for commercial sale.

Q. What environmental regulations apply to pork production?

A. Areas of environmental regulation include: groundwater, surface water, air quality; animal and manure disposal; land and soil quality; and land use.

Typically, permits are required at state and local levels for construction of structures ranging from animal housing units to manure storage systems. Operating permits for manure handling also may be required.

As in other industries, pork producers must meet or exceed all local, state, and federal environmental worker health and safety requirements. In brief, pork producers are faced with a multitude of regulations at all levels of government.

Q. Is hog manure toxic or hazardous to the environment?

A. When managed properly, manure presents little risk to the public or to the environment. The U.S. Environmental Protection Agency defines a toxic substance as a chemical or mixture that may pose an unreasonable risk of injury to human health or the environment. Hazardous substances include those that present a threat because they are characteristically toxic, corrosive, ignitable, explosive, or chemically reactive. Based on these definitions, hog manure is neither toxic nor hazardous.

When manure decomposes, it produces ammonia and hydrogen sulfide, as well as a variety of organic compounds. These compounds, many of which are nutrients necessary for plant growth, are also produced through decomposition processes in natural wetlands and all of them occur throughout the environment as a result of various natural processes.

Compounds in hog manure–like the compounds in a compost pile–are easily broken down into various nutrient sources for plant uptake. Because hog manure contains only low concentrations of these compounds and nutrients, the products of decomposition are rarely, if ever, present at levels that are toxic or hazardous to local plant and wildlife habitats or human populations. The sound environmental management practices of today's pork operations are designed to protect natural resources from excess nitrification, and high concentrations of manure when land applied.

Q. Are the elements found in hog manure contaminants or pollutants?

A. A contaminant is any substance or material that is not naturally present in the environment or that is naturally present at much higher levels. A pollutant is a contaminant that is present at levels that are high enough to make water unfit for its intended use.

The elements in hog manure if not managed correctly can be a contaminant or pollutant. Proper manure handling and management techniques avoid such problems by treating manure before it is

applied to the land and by limiting its application to rates that can be used by plants in natural nutrient cycling processes.

Inorganic copper (Cu), zinc (Zn), and phosphorus (P) are added to animal diets as essential nutrients for growth. If not properly managed the potential for these elements to accumulate in soils from land application is possible. Some of these supplements, like Zn, is more likely to be beneficial to crops than harmful, and many diets tend to be low in Zn. Soil texture, soil pH, climate, and soil water holding capacity are all factors pork producers consider before applying manure to pasture land or cropland.

With continual manuring, soil aggregation eventually is improved, soil water-holding capacity is increased, and air exchange is enhanced. Additionally, the soil often becomes a better medium of aerobic biological activity. Manure application, if not excessive, thus tends to improve soil quality over time.

Q. How do production and manure management techniques affect ecosystems and the environment?

A. Elements in hog manure are all naturally occurring compounds that biodegrade or easily dissipate. When manure is loaded and treated at appropriate rates in lagoons or other systems and is then properly applied to crop and pasture land, the effects on air, water, and soil components of local ecosystems are negligible.

When manure is used as fertilizer, it completes a sustainable system. Manure nutrients are used by forage or agricultural crops, particularly corn. Forage crops are typically made into hay used to feed cattle. Corn is used to feed all livestock species.

Modern manure management and treatment systems do not overburden local watersheds with nutrients in agricultural runoff, and any changes in local air quality are short term, nonhazardous, and typically involve odors detected at parts-per-billion levels. Because compounds in hog manure are naturally occurring and are not applied in excessive amounts, they are cycled through the ecosystem in the same way as other nutrient sources. As in any operation, occasional accidental releases may occur, but these accidental releases involve only naturally occurring nutrients, which are easily absorbed and incorporated into the environment, producing minimal long-term effects.

Q. Does manure or odor present a public health risk?

A. No. Elements and nutrients in manure do not present a public health risk because all compounds occur naturally and none are released to the environment at concentrations detrimental to air or water quality. The human nose is sensitive enough to detect some of these compounds at parts-per-billion levels, which are well below the concentrations that produce human health effects. While odors from pork operations may occasionally be distracting or irritating, they do not pose a health risk.

Responsible pork producers employ various methods to minimize the effects of odor on the surrounding community. For example, producers monitor climate and wind speed conditions before manure fertilizer applications. They ensure liquids drawn from lagoons have received adequate treatment to minimize odors before land application. Most important, they understand being a good neighbor is essential to the continued success of their business. As a result, responsible producers

plan ahead to avoid applying manure at times neighbors may be entertaining friends and relatives. Producers take proactive measures to avoid problems.

Q. Is manure a major cause of groundwater or surface water pollution?

A. Manure management systems that are properly managed do not contaminate groundwater or surface water resources. Properly constructed lagoons, particularly those with liners, thermal aeration systems, and other technologies, remove nutrients naturally present in manure before it is applied to soil or ground. The pork industry prides itself on its zero-discharge standard.

Other sources typically contribute to elevated nitrate levels. They include naturally occurring background levels in wetland areas, human sewage systems, and runoff from commercial fertilizers.

Well depth and its proximity to operational areas significantly affected nitrogen levels in groundwater. When wells are placed and installed properly, natural attenuating factors in groundwater systems effectively reduce the nutrient and bacteria concentrations to safe, typically nondetectable concentrations.

Q. If a water source is found to be contaminated, is it possible to distinguish municipal human waste, commercial fertilizers, and livestock manure?

A. Elements and nutrients found in municipal human sewage, commercial fertilizers, and livestock manure are all naturally occurring compounds. When present in groundwater or surface water, these compounds may be indistinguishable. For example, sewage from a septic tank contains the same basic elements and nutrients found in manure. As a result, it is difficult to determine the source once compounds have impaired a watershed.

Modern groundwater and surface water monitoring techniques allow pork producers to manage manure systems to avoid any environmental impacts to local water resources. Groundwater monitoring wells placed near pork operations are able to detect any nutrients that may be leaching from treatment lagoons or other areas. Surface water monitoring also can determine if manure applications are affecting local stream quality.

Producers use such wells and sampling efforts to ensure their operations do not degrade local water quality. In the event of an accidental spill, these monitoring systems can determine the potential increased nutrient load resulting from the spill. That data can be used to establish cleanup and redemption goals.

Q. Are people at risk from high nitrate levels in potable water?

A. The primary human health effect of excess nitrate levels in drinking water is methemoglobinemia, or “blue-baby syndrome.” That condition is extremely rare and documented cases in the United States are particularly unusual.

Nitrites and nitrates are naturally occurring compounds that result from various biological processes. Those processes include microbial decomposition that is an essential component of

nutrient cycling in natural ecosystems. Air itself is made up of about 70 percent nitrogen. Nitrogen cycling is essential for plants, wildlife, and atmospheric activity.

Although nitrates and nitrites may be dangerous to humans and wildlife in extremely high doses, pork production operations are rarely the primary contributing factor in groundwater or surface water contamination. Commercial fertilizer presents as much of a risk when overapplied or applied at the wrong time as does manure. When that happens, the plant is unable to use all the nutrient compounds and, as a result, groundwater or surface water can be contaminated.

Q. What is the risk of pathogenic transmission from hogs to humans?

A. The public is not at risk from any zoonotic diseases which are communicable among animals, particularly swine and humans. Farm workers, veterinarians, and slaughterhouse employees may, however, be susceptible to exposure throughout their daily activities. Although those who interact with the animals can potentially be exposed to zoonotic diseases, modern hygienic practices, producer and veterinarian knowledge of these diseases, and the development of antibiotics and vaccines minimize the already low risk for disease transfer from animals to producers. It is in the best interest of producers to maintain healthy animals and a safe working environment.

Pathogens present in water can be the result of feces or urine from various wildlife species such as deer, raccoons, opossums, rabbits, rats, mice, and squirrels as well as improperly applied livestock manure. Properly handled, stored, and applied manure will not jeopardize the integrity of surface water. For those pork operations permitted by state and federal agencies, the discharge of manure into lakes, streams or other surface water bodies is strictly prohibited unlike other non-agricultural permitted facilities which can and do. Public water systems are required to filter surface water sources and remove the risk of water contamination.

Q. Are population equivalents, like a 2.5 million head per year swine operation having potential waste output greater than the city of Los Angeles, accurate?

A. 1. Population equivalents are sometimes used to characterize the potential for animal production systems to create water pollution problems. This is incorrect since modern manure handling systems are designed, operated and required to prevent discharge into water bodies. A concentrated pork production operation of this size is subject to Clean Water Act requirements that all manure be contained at the site in a manner that does not contaminate surface or ground water. Additionally, any manure which is land applied from such a site must be applied in a manner that does not contaminate surface or groundwater.

2. City waste treatment facilities are typically permitted to discharge millions of gallons of nutrient laden effluent streams or other surface waters which contributes to contamination of the surface water and wastes the nutrient resources. Only about 20 percent of all municipal byproducts and residues are recycled.

A 2.5 million head pork operation can provide enough nitrogen fertilizer for 335,000 acres of corn, in addition to providing enough pork for more than five million people. Nationwide, the value of swine manure as fertilizer is estimated at $2.50 to $3.50 per market hog sold. There are more than 15,000 publicly owned waste water treatment facilities processing more than 31 billion gallons of waste water each day. They discharge 3.2 billion pounds of nitrogen directly into surface water each

year. This does not count discharges of raw sewage which frequently occur during times of heavy rain or equipment malfunction. EPA does not record these by-pass conditions.

3. Here's how humans and pigs compare when they are compared on an equivalent pollutant mass loading basis for nitrogen, phosphorus and BOD (biological oxygen demand). A 3,600 head pig finishing operation is equivalent to 270 people for BOD, 1,580 people for nitrogen and 2,150 people for phosphorus.

4. The United States has approximately 330 million acres of cropland and 650 million acres of pasture and rangeland. This provides an ample base for land application of livestock manure. In only a limited number of counties nationwide does the supply of animal manure greatly exceed the cropland (not including forages, pasture and rangeland) available for manure use.

Q. Does manure pollute drinking and surface water with nitrates, parasites, bacteria and viruses?

A. 1. The most common cause of bacterial problems in drinking water wells is well deterioration. Many people use old wells; some were poorly constructed to begin with. In others, age has taken its toll, resulting in loose or missing caps, corroded or cracked casings, and other defects.

2. Available epidemiological data do not suggest any increase in the incidence of diseases caused by waterborne human pathogens such as Salmonella or Leptospira as a result of increased swine production in North Carolina. From 1989 to 1995, the hog population increased from 2.7 million to 7 million in the state, but the annual incidence of reported Salmonella infections remained unchanged. Most cases occur in populous, urban counties. Also, modern swine management practices in North Carolina appear to have virtually eliminated swine infection by toxoplasmosis.

3. An evaluation of 29 polluted wells in Sampson County, North Carolina (the second largest pork production county in the U.S.) was conducted using isotope analysis developed by North Carolina State University. The analysis can determine differences between industrial, human or animal waste. The isotope analysis showed two-thirds of the 29 wells were contaminated with synthetic fertilizer. The rest had more than one source of contamination, including septic pollution and organic nitrogen. Animal waste was a minor influence in only two wells.

4. Manure stored in the anaerobic condition, which is associated with many concentrated animal feeding operations, does not contain nitrates.

5. Because of cropping schedules, weather and the need to avoid soil compaction, most land application of manure slurry takes place in the fall of the year. However, seasonal nitrate levels in Midwestern streams typically peak in spring as a result of the soil mineralization process which generates nitrate nitrogen and the fact that precipitation is higher in the spring. Several states mandate training and certification for pork producers and employees who apply manure fertilizer, but not manufactured fertilizer.

6. Phosphorus concentrations exceed stream limits recommended by the EPA in 75 percent of urban streams sampled but only 25 percent of agricultural streams sampled.

7. Concentrated swine feeding operations are required to completely contain all manure at the production site to prevent movement of nutrients and pathogens to surface or groundwater.

Producers are also required to land apply manure in a manner that prevents contamination of surface or groundwater.

8. EPA defines a toxic substance as a chemical or mixture that may pose an unreasonable risk of injury to human health or the environment. Hazardous substances include those that present a threat because they are characteristically toxic, corrosive or chemically reactive. By definition, hog manure is neither toxic nor hazardous.

9. Elements in hog manure do not present a public health risk because all compounds occur naturally and none are released to the environment at concentrations detrimental to air quality.

10. The occurrence of toxic forms of Pfiesteria is a complex process. Blooms in these dinoflagellate populations are responsible for the occurrence of "red tides" in coastal areas which are triggered by a combination of environmental factors, all of which must occur simultaneously. The factors include: 1) The presence of a large school of feeding fish. Large schools of feeding fish produce fresh excrement, which appears to be the stimulus for transformation of the dinoflagellate into toxic forms. 2) A nutrient-enriched body of water with elevated levels of nitrogen and phosphorus. 3) Moderate salinity. These organisms are only known to exist in estuaries, where fresh and salt water mix, generally at the mouth of a freshwater river that empties into a marine environment. While nationwide, pork production accounts for only 12-15% of all animal manure, the pork industry has taken the lead in developing manure management education programs and in seeking the development of science-based regulations to protect the environment.

11. The public is not at risk from any zoonotic diseases which are communicable among animals, particularly swine, and humans. Properly handled, stored and applied manure will not jeopardize the integrity of surface water. For concentrated pork operations, the discharge of manure into lakes, streams or other surface water bodies is strictly prohibited.

Q. Do inadequate waste management practices lead to water pollution?

A. 1. In some major pork production states, up to 80 percent of manure slurry from concentrated pork production operations is now injected directly into the soil at the root zone. This practice preserves the valuable crop nutrients in manure, virtually eliminates odor and runoff potential and places the nutrients where crops can use them. Hog manure is very valuable in restoring soil productivity and will bring soil back to a higher level of productivity than it had before because of the organic nutrient content.

2. A significant potential source of nutrients in ground and surface water is the use of private septic systems. It's estimated 66 million Americans rely on septic systems for waste treatment producing up to 45 gallons per person per day of waste water. Septic effluent is typically deposited in trenches 18 to 24 inches below the surface, well below the root zone of most crops.

3. On a per acre basis, a septic system's output can equate to application of total nitrogen of more than 700 pounds per acre, more than four times the amount typically applied from swine manure for corn production at 150 bushels per acre.

4. Urban land use activities can increase the risk of groundwater contamination, even when agricultural sources of nitrogen are lacking. Groundwater nitrate concentration is high (median of 8.9 mg/L) in heavily populated areas like Long Island, New York, even though nitrogen loadings

from commercial fertilizer, manure and atmospheric sources are low according to the U.S. Geologic Survey. Septic systems and cesspools have been a major source of nitrate in groundwater for years. Public supply wells in Nassau County were abandoned almost fifty years ago because of nitrate contamination. Residential fertilizer contributed the equivalent of 182 pounds of nitrogen per acre in that urban county according to USGS, enough nitrogen to raise more than 150 bushels of corn to the acre.

5. U.S. Geologic Survey studies indicates nitrate levels in groundwater samples in the Northeastern United States increase significantly as population increases.

For more information contact: National Pork Board at www.pork.org or
Wisconsin Pork Association at wppa@wppa.org or www.wppa.org

Addendum C: Additional Information by Supervisor Middleton

At the May 13, 2020 Environmental Service Committee, Supervisor Middleton provided comments, additional information and suggested changes to the initial CAFO report. Below is a summary of this information:

I. Health Impacts of Covid-19 & African Swine Fever Virus

A. Covid-19

Huge corporate-owned hog processors across the nation and Wisconsin are seeing Covid-19 infection rates among workers as high as 25%. These high rates have forced more than 100 plants to close, according to a May 8, 2020 Centers for Disease Control (CDC) report.
The giant Chinese-owned Smithfield hog processing plant in Sioux Falls, SD was one of the first to close. There are 850 infections tied to the plant. According to an October 2, 2019 interview with hog factory developer, Jeff Sauer by the Town of Laketown Moratorium on Livestock Facility Licensing Committee, this is the plant driving investors to build a complex of hog farrowing and finishing plants in Polk and Burnett counties. While Sauer's investors hope to operate the plants, Smithfield would own the sows and lease them to the operators.

The closure of all these processors means that factory farms have nowhere to ship their animals. In fact, National Pork Producers Council president, Howard Roth said on April 29, 2020 that "millions of pigs can't enter the food chain" and will have to be killed and disposed of. The Brazilian-owned JBS plant in Worthington, MN reopened on April 29 and is euthanizing, not processing, up to 13,000 hogs a day and the "carcasses will be rendered, sent to landfills, composted or buried."

Without effective, enforceable mortality plans, this highly concentrated production system will leave Polk County vulnerable when the hog factories have to dispose of tens of thousands of hogs due to future pandemic shutdowns.

While the US Department of Agriculture has recommended procedures for mass depopulation, it is very challenging and presents many disposal issues.

African Swine Fever Virus
Millions of hogs have died or been killed globally due to African Swine Fever (ASF), or commonly called, hog Ebola. Experts predict 25 percent of the global herd will perish. The disease is 100% fatal and the pathogen is especially hardy. Asian countries such as China, Vietnam and Korea have been hit hard - Aporkalypse Now. Germany is building a wall along its Polish front to stop the invasion.
In response, the USDA held simulated exercises with 14 states in September 2019 to test our nation's ability to control an outbreak. While the exercises themselves were covered by industry press, there has been almost no coverage of the potential problems identified. Most of the focus is on how much tax payers will have to reimburse these giant corporations for the dead animals. While Wisconsin was not one of the 14 states that did simulations, DATCP staff did observe the Minnesota exercise. In addition, DATCP has published a 1-1/2 page African Swine fever factsheet. October 2019 interviews with the Wisconsin Department of Agriculture Trade and Consumer Protection's Rebecca Slater, Emergency Response Coordinator and Dr. Julie McGwin, Veterinarian Specialist, identified multiple issues, including:

1.) In the event of an outbreak, thousands of trucks hauling up to a million hogs would be required to comply with a stop movement order for up to 72 hours. Standstills such as this are very hard to enforce. After 72 hours the animals - many of them weanlings - start to die.
2.) A 10km quarantine ring would be put around any infected factory, heavily impacting locals.
3.) Procedures for handling effluent from the washing of infected trucks and factories are not clear.
4.) Procedures for killing tens of thousands of hogs in a factory are not clear.
5.) Composting and incineration are the recommended disposal techniques for carcasses once herds are killed. Wisconsin lacks sufficient capacity for either method. In addition, the robust pathogen, types of infected materials (metal cages, feeds, etc.) and Polk County's high water table make the efficacy of composting questionable. Impact of compost leachate on ground water is unclear. Landfills did not want avian flu carcasses and concerns about taking so many dead hogs are expected to be even higher.
6.) USDA's Disease Response Strategy - African Swine Fever raises many issues about disposal, including this quote from page 15:

> "Due to the persistent nature of ASFV (African Swine Fever Virus), options for disposal are limited. For example, composting may not be feasible when there are large amounts of biomass; resources for rendering are currently limited. Burial poses significant challenges with environmental contamination and the ability of the ASFV to persist in the environment. Each option has its own environmental, logistical, and managerial challenges. APHIS and State officials and subject matter experts will collaborate to determine best approaches. "

Mortality Planning

https://www.ncbi.nlm.nih.gov/pubmed/30228132

II. Economic Impact on Existing Livestock Industry & Property Values

Recommendation *- Assess impact of swine factories on existing Polk County plans related to economic development.*

Background for Recommendation
Line 23 of Resolution 33-19 clearly states that one of the county's Comprehensive Plan goals for agriculture is to "make Polk County self-sufficient." In addition, Section IV, paragraph 3 of Resolution 33-19 specifically says that the purpose of the ordinance is to review the Comprehensive Plan "or other Polk County plans or policies" that might need modification.
However, the report makes no reference to any of the county's existing plans. Most importantly, there is no look at how the swine industry will impact two challenges:

A. Maintaining Existing Livestock Producers & Processors
B. Protecting Property Values

A. Maintaining Existing Livestock Producers & Processors

The report should document impacts the corporate livestock industry may have on the county's existing livestock producers and meat processors. Hundreds of small farms produce high quality protein right here. Clear Lake, Amery, St. Croix Falls, Luck and Frederic all have processors. Input from both of these types of business, as well as hog farm developer Jeffery Sauer from Cumberland LLC, should be included.

More information on the many alternatives to large corporate factory farm is also needed. Our region is a leader in this field. Midwest Organic and Sustainable Education Service's annual conference in La Crosse, Wisconsin attracts thousands of participants. Both the University of Wisconsin and Minnesota have a range of programs. A bit farther afield is John Ikerd, from the University of Missouri. Ikerd has an easily accessible collection of papers on how agriculture can help local communities thrive and is available for interview.

Wisconsin Farmers' Union made several attempts to showcase the thriving producer community in Polk County for staff and supervisors. They are still open to providing information to the study process.

B. Protecting Property Values

The financial health of county government and our citizens is based in large part on property values. The report needs to include information on how investors' plans to build a swine factory industry here will impact property values. We do know that attempts by hog factory developers in the towns of Laketown and Sterling to buy property caused immediate concerns about property values and motivated people to list their homes.

These concerns are not unfounded. These factories bring a range of negative impacts to communities, including unregulated air and noise pollution. Ammonia, hydrogen sulfide, endotoxins, viruses and bacteria from these factories are absorbed by dust particles and can stay airborne for long periods, traveling several miles. Research from North Carolina, one of the states most impacted by the swine factory farms, shows increased rates of infant deaths and deaths from to anemia, kidney disease, tuberculosis, and septicemia in nearby communities.
In one local example, Jeffery Sauer told Laketown citizens that his planned 26,000 hog facility would be ventilated by an estimated one hundred 6-foot exhaust fans running all day, every day.

Information on Property Values near CAFOs
According to articles and studies, impacts to property values on land and homes near CAFOs appears to be variable. A number of factors go into determining if property values are affected and by how much. A residential house in close proximity (within a mile) to the CAFO and downwind experience the highest potential for property value reduction. Impact to value tends to dwindle to negligible when the distance from the CAFO reaches 2.5-3 miles. The type and number of animals in the facility also has an effect on the impact to value. Property values can increase near CAFO's due to the increased economic activity or by demand for housing for workers at the facility. Table 1 shows the estimated property value changes near CAFOs.

Table 1. *Estimates of property value loss from location of animal feeding operation*

Authors	State	Animal Type	Change in Property Price
Bayoh, Irwin, Roe	Ohio	Various	Small
Herriges, Secchi, Babcock	Iowa	Swine	-6% to +4%
Kim, Goldsmith, Thomas	North Carolina	Swine	-2%
Palmquist, Roka, Vukina	North Carolina	Swine	-3.6% to 0 %

Notes: Estimates reflect the percentage reduction of the price of a house when a CAFO (1000 animal units) is located at a distance of 1 mile from the home. The exception is Herriges, Secchi, and Babcock whose range of estimates is for a 1.5 mile distance from the home. Kim, Goldsmith, and Thomas use assessed value of the home rather than a purchase price.

Source: Purdue University Extension Publication #ID-363-W: Community Impacts of CAFOs: Property Values. Available at: https://www.extension.purdue.edu/extmedia/ID/ID-363-W.pdf

Additional Sources:
Indiana Business Research Center. The Effect of Regulated Livestock Operations on Property Values in Selected Indiana Counties. September 2008. Available at: https://www.ibrc.indiana.edu/studies/indiana_cafo_cfo_property_impact_2008.pdf

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Ulmer, Ann and Massey, Ray. Animal Feeding Operations and Residential Land Value; University of Missouri Extension – Agricultural Economics Extension # MP748 2006. Available at: https://farmanswers.org/Library/OpenItem/3770

III. Laws & Enforcement, Town of Eureka Ordinance

Recommendation - Meet requirements of Resolution 33-19 Section IV, paragraph 5. *Include a discussion of:*

A. *Laws, Regulation & Rules Governing Large Livestock Facilities*
B. *Enforcement at Large Livestock Facilities*
C. *Town of Eureka Concentrated Animal feeding Operations Ordinance*

Section IV, paragraph 5 of Resolution 33-19 plainly states that the purpose of the moratorium is to allow "time to ensure all State of Wisconsin Statutes, Administrative Codes and other applicable laws and regulations are accounted for in any Polk County regulatory structure."

This part of the study process is especially important because the swine factory developers claim that laws and enforcement are already in place to safely regulate their industry. County supervisors require a complete understanding of the laws that govern this industry as they make decisions that will impact the health and economy of our people for decades to come.
In order to fill this need, the report should include a chart that lays out the federal and state statutes and regulations which govern large livestock facilities. Equally important, would be documentation of any regulatory holes and shortages in in enforcement. Finally, a careful look is needed at the Town of Eureka's Concentrated Animal feeding Operations Ordinance.

A. Laws, Regulation & Rules Governing Large Livestock Facilities

The next version of this report should include a coherent summary of the laws, regulations and rules that govern swine factories. A concise four page draft presented at the December 18, 2019 meeting of the Town of Laketown Moratorium on Livestock Facility Licensing Committee is available to the public. It could serve as an excellent starting point. (See Appendix B.)
A complete accounting of the gaps in current federal, state and local laws is also needed, including but not limited to:

1. Lack of air pollution regulation under the federal Clean Air Act or complete draft models for ammonia, hydrogen sulfide and particulate matter pollution from swine plants.
2. Exemption of animal factories in 2019 from reporting requirements under the federal Emergency Planning and Community Right-to-Know Act (EPCRA).
3. No regulations for the thousands of corpses and placenta produced at these plants.
4. No requirement for mortality plans.
5. Need for fact-based setbacks and lack of statutory authority for $1,000 limit on application fees and a prohibition on performance bonds under Wisconsin's Large Livestock Siting law Wisconsin Statute 93.90.
6. Issues hindering Wisconsin's manure management rules to stop water pollution.
7. Need for High Capacity Well regulations to protect surrounding wells, rivers and lakes.

B. Enforcement at Large Livestock Facilities

Uneven enforcement of large livestock facilities under the federal Clean Water Act (CWA) also needs documentation in the report. Passed in 1972 under President Nixon, the CWA requires plants to get a permit for water pollution. While it is a federal law, authority for implementation and enforcement is granted to Wisconsin Department of Natural Resources (DNR). Under the CWA, DNR is required to ensure that Wisconsin's approximately 318 large livestock farms, known as Concentrated Animal Feeding Operations (CAFOs), are complying with the terms of their permits.

These 5-year permits place limits on the type and concentration of water pollutants that may be discharged, require ongoing self-monitoring and reporting and establish requirements for manure collection and land application procedures.

The DNR is struggling to permit, monitor and take enforcement actions of these plants. A 2016 review by the state's Legislative Audit Bureau found significant problems with the program's ability to keep up with its workload. As of May 11, 2020, 83 (26%) of the state's 318 CAFOs are operating under expired permits. There are five CAFOs in Polk County. One is operating under an expired permit.

No case better illustrates enforcement problems at CAFOs than ongoing problems at the Emerald Sky Dairy. Located near Baldwin in St. Croix County, Emerald Sky has had five known manure violations in three years. The worst was a 2017 spill of 275,000 gallons that resulted in only an $80,000 fine. Things are so bad that the St. Croix County Development Corporation sent a letter to the DNR on February 20, 2020 demanding "full and quick enforcement of manure application rules and statutes for CAFO's located in St. Croix County."

There may soon be even less enforcement. A March 26, 2020 EPA Memorandum unveiled a "temporary" enforcement discretion policy which permits normally-regulated US facilities to ignore current environmental standards during the COVID-19 pandemic. There is no end date to the policy and it does not even reserve the right to act in the case of an imminent public health threat.

C. Town of Eureka Concentrated Animal Feeding Operations (CAFO) Ordinance

As mentioned in my overview, the Town of Eureka passed a comprehensive operations ordinance in January 2020. That ordinance is built on one of the three Wisconsin statues that we could use to develop a county-wide ordinance. It deserves careful consideration

Like the Town of Osceola that I represent, Eureka adopted county zoning with the idea that the county would be a valuable resource as new development issues arise. Instead, Eureka and the un-zoned towns of Laketown and Sterling - the three towns most imminently threatened by investors looking to build new hog factories - are each having to reinvent the wheel themselves.

Our towns and the public are counting on the county to do the work needed to provide a thorough study of the large livestock issue. I look forward to being part of that process.

Amy Middleton - Polk County Supervisor District 10
Comments on Polk County Large-Scale Livestock Facility Study Group Report
Appendix A - List of Cited Sources

Overview

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Polk County - Temporary Moratorium on Livestock Facilities.
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Enforcement

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https://www.documentcloud.org/documents/6152219-Wastewater-Permitting-and-Enforcement-DNR-June.html

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Town of Eureka Ordinance

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Clean Water Act - 1972	Water pollution permits for manure.	Implementation and enforcement authority delegated to the DNR.
Clean Air Act - 1990	Criteria pollutants - carbon monoxide, lead, ground-level ozone, nitrogen dioxide, particulate matter, and sulfur dioxide. Not currently required for CAFOs.	Implementation and enforcement authority delegated to the DNR.
Emergency Planning & Community Right-to-Know Act 1986	Chemicals released to the air, land or water. Not currently required for CAFOs.	Implementation and enforcement authority delegated to the DNR.
Air Pollution Models - 2007	Ammonia, hydrogen sulfide, particulates and volatile organic compounds. Not currently required for CAFOs.	US EPA
Wisconsin State Law or Regulation	**Type of Regulation**	**Regulating Agency**
Runoff Management Rules (NR151)	Manure and fertilizer.	DNR
Local Regulation of Livestock Law (92.15)	Local government may exceed state standards if need to protect water quality. May require review by DNR or DACTP.	DNR or DATCP
Air Toxics Rule Regulation (NR 445)	Not currently regulated. Potentially hydrogen sulfide & ammonia.	DNR
High Capacity Wells (NR812)	Required when pumping more than 70 gallons per minute of water.	DNR
Livestock Siting & Expansion Law (93.90)	Local governments can adopt authority for siting. No authority in Laketown because neither Laketown nor Polk County has adopted.	DATCP
Livestock Facility Siting Rule (ACTP 51)	Setbacks, air pollution, nutrient and runoff management, and waste storage.	DATCP
Polk County Regulation	**Type of Regulation**	**Regulating Agency**
Comprehensive Land Use Ordinance	CAFOs currently allowed in all agricultural zones. Laketown is not zoned.	Polk County Zoning
Shoreland Protection Zoning Ordinance	Need more information	Polk County Zoning
Manure & Water Quality Management Ordinance	Manure managed under NRCS cost share.	Polk County Land & Water
Storm Water Management & Erosion Control Ordinance	Construction plans reviewed for water & erosion	Polk County Land & Water
Laketown Regulation	**Type of Regulation**	**Regulating Agency**
Comprehensive Plan	Need more information	Laketown
Large Scale Commercial Activity Ordinance	Need more information	Laketown
Road Access & Vehicle Weight Limits	Need more information	Laketown

TOWN OF EUREKA
POLK COUNTY, WISCONSIN

ORDINANCE NO. _____
CONCENTRATED ANIMAL FEEDING OPERATIONS ORDINANCE

The Town Board of the Town of Eureka, Polk County, Wisconsin, does ordain as follows:

Section 1. Authority

This Ordinance is adopted pursuant to the powers granted under Wisconsin Constitution, and Wisconsin Statutes including but not limited to Section 92.15. This Ordinance is further adopted pursuant to the powers granted to the Town Board under the grant of village powers pursuant to Sec. 60.22 of Wis. Statutes for the protection of public health, safety and general welfare.

Section 2. Purpose and Findings

The purpose of this Ordinance is to effectively, efficiently and comprehensively regulate the operation of Large-Scale Concentrated Animal Feeding Operations of 1,000 animal units or greater ("CAFO") in the Town of Eureka, without respect to siting, to protect public health (including human and animal health), safety, and general welfare, to prevent pollution and the creation of private nuisances and public nuisances, and to preserve the quality of life, environment, and existing small-scale livestock and other agricultural operations of the Town of Eureka and to achieve water quality standards within the Town of Eureka. This Ordinance sets forth the procedures for obtaining a CAFO Operations Permit for the operation of new and expanded livestock facilities in the Town of Eureka (sometimes referred to as "the Town").

The need for this Ordinance is based upon the Town's obligation to protect the health, safety and general welfare of the public and is based upon reasonable and scientifically defensible findings, as adopted by the Town Board, clearly showing that these requirements are absolutely necessary to protect public health and safety. Specifically, the Town finds that there is ample scientific research and evidence establishing that CAFO's pose a significant risk to the integrity of the Town's groundwater, surface water, air quality, the health and well-being of its residents and local property values. These findings are based in part on the scientific articles and research studies discussed and listed below and in Appendix A.

On November 2, 2019, the American Public Health Association enacted a policy statement advising federal, state and local governments and public health agencies to impose a moratorium on all new and expanding CAFOs recommending a complete halt until additional scientific data has been collected and public health concerns associated with CAFOs are addressed.

CAFOs confine large numbers of animals of the same species—such as beef and dairy cattle, swine, broilers (poultry raised for meat consumption) and laying hens—on a small area of land. The scale, density, and practices associated with these operations present a range of public health and ecological hazards, including large volumes of untreated animal waste, the release of environmental contaminants to air, water, and soil, and the generation and spread of antibiotic-resistant pathogens. There is a significant body of evidence which shows CAFOs are directly

associated with occupational and community health risks, as well as the social and economic decline of rural communities.

In 2010, the National Association of Local Boards of Health published a report identifying the following Environmental Health Effects of CAFOs:

1. Groundwater
2. Surface Water
3. Air Quality
4. Greenhouse Gas and Climate Change
5. Odors
6. Insect Vectors
7. Pathogens
8. Antibiotics
9. Property Values

Pollutants commonly found in air surrounding CAFOs include the following:

CAFO Emissions	Source	Traits	Health Risks
Ammonia	Formed when microbes decompose undigested organic nitrogen compounds in manure	Colorless, sharp pungent odor	Respiratory irritant, chemical burns to the respiratory tract, skin, and eyes, severe cough, chronic lung disease
Hydrogen Sulfide	Anaerobic bacterial decomposition of protein and other sulfur containing organic matter	Odor of rotten eggs	Inflammation of the moist membranes of eye and respiratory tract, olfactory neuron loss, death
Methane	Microbial degradation of organic matter under anaerobic conditions	Colorless, odorless, highly flammable	No health risks. Is a greenhouse gas and contributes to climate change.
Particulate Matter	Feed, bedding materials, dry manure, unpaved soil surfaces, animal dander, poultry feathers	Comprised of fecal matter, feed materials, pollen, bacteria, fungi, skin cells, silicates	Chronic bronchitis, chronic respiratory symptoms, declines in lung function, organic dust toxic syndrome

Pathogens found in animal manure that have been determined to cause illness in humans include the following:

Pathogen	Disease	Symptoms
Bacillus anthracis	Anthrax	Skin sores, headache, fever, chills, nausea, vomiting
Escherichia coli	Colibacilosis, Coliform mastitis-metris	Diarrhea, abdominal gas
Leptospira pomona	Leptospirosis	Abdominal pain, muscle pain, vomiting, fever
Listeria monocytogenes	Listerosis	Fever, fatigue, nausea, vomiting, diarrhea
Salmonella species	Salmonellosis	Abdominal pain, diarrhea, nausea, chills, fever, headache
Clostirdum tetani	Tetanus	Violent muscle spasms, lockjaw, difficulty breathing
Histoplasma capsulatum	Histoplasmosis	Fever, chills, muscle ache, cough rash, joint pain and stiffness
Microsporum and *Trichophyton*	Ringworm	Itching, rash
Giardia lamblia	Giardiasis	Diarrhea, abdominal pain, abdominal gas, nausea, vomiting, fever
Cryptosporidium species	Cryptosporidosis	Diarrhea, dehydration, weakness, abdominal cramping

Researchers at the Johns Hopkins Center for a Livable Future have found that the primary human health concerns related to industrial food animal production (IFAP) (also referred to as concentrated animal feeding operations (CAFOs)) include: infections resulting from transmission of harmful microorganisms from animal operations to nearby residents; respiratory effects from increased exposure to air pollution from animal operations; and multiple negative health impacts due to increased exposure to ground and/or surface waters that can be contaminated by manure from animal operations.

Disease Transmission

The poor conditions, including crowding, characteristic of industrial animal operations present opportunities for disease transmission among animals, and between animals and humans. [1-2] (Footnotes refer to sources listed in Appendix A, References.) Nearby residents may have an increased risk of infection from the transmission of harmful microorganisms from operations via flies or contaminated air and water. [3-9]

Of additional concern is exposure to pathogens that are resistant to antibiotics used in human medicine. Administering antibiotics to animals at levels too low to treat disease (non-

therapeutic use) fosters the proliferation of antibiotic-resistant pathogens, and this practice is common in CAFOs. Resistant infections in humans are more difficult and expensive to treat [10] and more often fatal [11] than infections with nonresistant strains. A growing body of evidence provides support that antibiotic-resistant pathogens are found on animal operations that administer antibiotics for non-therapeutic purposes [12-13] and are also found in the environment in and around production facilities, [13-15] specifically in the manure, [16-18] air, [13] and flies. [19]

Manure runoff from CAFO operations may introduce these harmful microorganisms into nearby water sources. [20] Land application of manure presents an opportunity for pathogens contained in the manure to leach into the ground or run off into recreational water and drinking water sources, potentially causing a waterborne disease outbreak. [17] This is of particular concern for residents who rely on private wells for drinking water and household use; [21] private wells are not monitored by government agencies to ensure safe levels of pathogens.

Air Pollution

Community members living near CAFO operations also face increased exposure to air pollution from these operations, which can cause or exacerbate respiratory conditions including asthma [22-24]; eye irritation, difficulty breathing, wheezing, sore throat, chest tightness, nausea [25]; and bronchitis and allergic reactions. [23] Air emissions include particulates, volatile organic compounds, and gases such as nitrous oxide, hydrogen sulfide, and ammonia. [22,26] Odors associated with air pollutants from large-scale hog operations have been shown to interfere with daily activities, quality of life, social gatherings, and community cohesion [22, 27-29] and contribute to stress and acute increased blood pressure. [29-30]

Contaminated Ground and Surface Water

The increase in concentration of livestock and poultry and transition to large, high-density, confined animal feeding operations over the last several decades has resulted in the concentration of animal waste over small geographic areas. [17] Although animal manure is an invaluable fertilizer, waste quantities of the magnitude produced by CAFO operations represent a public health and ecological hazard through the degradation of surface and ground water resources.[17] (For example a CAFO application recently submitted to Burnett County, WI indicated that the proposed operator expected a single facility to generate in excess of 9 million gallons of manure per year and that it intended to dispose of that waste by spreading it on local farm fields.)

Manure from these operations can contaminate ground and surface waters with nitrates, drug residues, and other hazards, [6, 31-33] and studies have demonstrated that humans can be exposed to waterborne contaminants from livestock and poultry operations through the recreational use of contaminated surface water and the ingestion of contaminated drinking water. [32-34] Exposure to elevated levels of nitrates in drinking water is associated with adverse health effects, including cancer, [35-38] birth defects and other reproductive problems, [34,35,39,40] thyroid problems, [34-35] and methemoglobinemia. [34, 41]

Nutrient runoff (including nitrogen and phosphorus) has also been implicated in the growth of harmful algal blooms, [17, 42] which may pose health risks for people who swim or fish in recreational waters, or who consume contaminated fish and shellfish. Exposure to algal toxins has been linked to neurological impairments, liver damage, gastrointestinal illness, severe dermatitis, and other adverse health effects. [43-44]

Given the potential impacts to health, safety and general welfare, the Town has an obligation to enact reasonable regulations on the operations of CAFOs.

In addition to the general impacts, the Town of Eureka has also determined that this Ordinance is necessary to achieve water quality standards under Wis. Stat. 281.15 which are designed to protect the public interest including the present and prospective future use of the Town's water for public and private water systems, propagation of fish and aquatic life and wildlife, domestic and recreational purposes and agricultural, commercial, industrial and other legitimate uses.

The waters of the Town of Eureka are vitally important to its residents and the impacts of CAFOs on water systems, fish and aquatic life, agricultural, commercial and industrial uses require the Town's protection and regulation. Water contamination and impairment may result in detected levels of veterinary antibiotics, elevated levels of nitrates and the presence of pathogenic organisms.

Elevated nitrates in drinking water can be harmful to infants leading to various syndromes and the possibly of death. Low blood oxygen in adults can also lead to birth defects, miscarriages and poor general health.

Before a CAFO may begin operation within the Town of Eureka, it is imperative that the operational risks be analyzed, base lines be established to control medical risks and the monitoring of each risk be established for evaluation and appropriate review.

It is for these reasons the Town of Eureka enacts this Ordinance.

Section 3. Definitions

1. "Applicant" or "permittee" refer to the entity seeking a CAFO Operations Permit under the terms of this Ordinance.

2. “Large-Scale Concentrated Animal Feeding Operation” or “CAFO” means a lot or facility, other than a pasture or grazing area, where 1,000 or more animal units have been, are, or will be stabled or concentrated, and will be fed or maintained by the same owner(s), manager(s) or operator(s) for a total of 45 days or more in any 12-month period. Two or more smaller lots or facilities under common ownership or common management or operation are a single Large-Scale Concentrated Animal Feeding Operation or CAFO if the total number of animals stabled or concentrated at the lots or facilities equal 1,000 or more animal units and at least one of the following is true: (1) The operations are adjacent; (2) The operations utilize common systems for the land spreading of manure or wastes; (3) Animals are transferred between the lots or facilities; (4) The lots or facilities share staff, vehicles, or equipment; or (5) Manure, barnyard runoff or other wastes are comingled in a common storage facility at any time.

3. “Operations” means a course of procedure or productive activity for purposes of conducting and carrying on the business of a CAFO including populating animal housing facilities, storing and managing animal and other waste materials, and conducting any other business activities.

4. “Pollution” means degradation that results in any violation of any environmental law as determined by an administrative proceeding, civil action, criminal action or other legal or administrative action investigation or proceeding.

5. “Private Nuisance” means a nontrespassory invasion of another’s interest in the private use and enjoyment of land, and the invasion is either: (1) intentional und unreasonable, or (2) unintentional and otherwise actionable under the rules of controlling liability for negligent or reckless conduct, or for abnormally dangerous conditions or activities.

6. “Public Nuisance” means a thing, act, occupation, condition or use of property which shall continue for such length of time as to “ (1) substantially annoy, injure or endanger the comfort, health, repose or safety of the public; (2) in any way render the public insecure in life, health or in the use of property; or (3) unreasonably and substantially interfere with, obstruct or tend to obstruct or render dangerous for passage or public use any street, alley, highway, navigable body of water or other public way or the use of public property or other public rights.

Section 4. License Required

Regardless of siting, a livestock facility with 1,000 or more animal units shall be allowed to conduct operations within the Town of Eureka only as provided under this Ordinance. Applicants shall apply for a CAFO Operations Permit to operate in the Town of Eureka under this Ordinance prior to conducting any operations.

1. General

A CAFO Operations Permit issued by the Town of Eureka is required for new or expanded livestock facilities that will operate with 1,000 or more animal units.

2. Licenses for Existing Livestock Facilities

A CAFO Operations Permit is required for the expansion of a pre-existing or previously approved livestock facility if the number of animal units kept at the expanded livestock facility will exceed 1,000 animal units.

Section 5. Licensing Administration

The Town Board shall administer this Ordinance and related matters thereto and shall have the authority to issues licenses under this Ordinance.

Section 6. License Application and Standards

The applicant shall apply for a CAFO Operations Permit prior to conducting any operations associated with a Large-Scale Concentrated Animal Feeding Operation in the Town of Eureka. The application shall be submitted on a form provided by the Town Clerk.

The Town Board shall decide whether to approve and issue a CAFO Operations Permit to an applicant that has submitted a complete application and paid the required application fee, after holding a public hearing on the application and considering any evidence concerning the application and the proposed operation presented by the applicant and any other interested persons or parties, including members of the public, other governmental agencies or entities, special legal counsel and expert consultants who may be hired by the Town Board to review the application and advise the Town Board.

The Town Board shall approve and issue a CAFO Operations Permit, either with or without conditions, if it is determined by a majority vote of all members, supported by clear and convincing evidence presented by the applicant, that: the applicant can and will comply with all conditions imposed by the Town; that the applicant's operations as proposed, with or without conditions, will protect public health (including human and animal health), safety, and general welfare, prevent pollution, prevent the creation of private nuisances, prevent the creation of public nuisances and preserve the quality of life, environment, existing small-scale livestock and other agricultural operations of the Town of Eureka; and that the applicant and the application meet all other requirements of this Ordinance.

Section 7. License Application Fee

A non-refundable application fee of One Dollar ($1.00) per proposed animal unit payable to the Town of Eureka shall accompany an application for the purpose of offsetting the Town costs to review and process the application.

Section 8. Application Procedure

1. An applicant for a CAFO Operations Permit shall complete a Town of Eureka CAFO Operations Permit Application and pay the required application fee. The applicant must be an owner or officer of the corporate entity proposing to operate the CAFO.

2. Upon signing and submitting a CAFO Operations Permit Application to the Town Clerk, the applicant shall agree to fully compensate the Town for all legal services, expert consulting services, and other expenses which may be reasonably incurred by the Town in reviewing and considering the application, regardless of whether or not the application for a permit is subsequently approved, with or without conditions, or denied by the Town Board. The applicant shall submit an administrative fee deposit as required by the Town Clerk.

3. After receiving the application and the application fee, the Town Clerk shall mail a notice that a CAFO Operations Permit Application has been received to all landowners within 3 miles of the proposed CAFO with the date and time of a Town Board meeting at which the application will be considered. The notice shall provide information on how interested persons and parties may inspect and obtain a copy of the application.

4. The Town Clerk shall place the application on the agenda for the next regular Town Board meeting for which required notice can be provided.

5. At a formal public hearing held by the Town Board on the application at least sixty (60) days after it has been determined to be complete, the Town Board shall consider any evidence concerning the application and the proposed CAFO presented by the applicant and any other interested persons or parties, including members of the public and other governmental agencies or entities, and special legal counsel and expert consultants who may be hired by the Town to review the application and advise the Town Board.

6. In its review and consideration of a CAFO Operations Permit Application, the Town Board shall act in a quasi-judicial capacity, and its final decision on whether to approve and issue a CAFO Operations Permit, either with or without conditions, shall be based on written findings of fact and conclusions of law consistent with the provisions of this Ordinance, which shall be filed with the Town Clerk and served on the applicant by regular U.S. Mail.

7. The Town Board shall approve and issue a CAFO Operations Permit, either with or without conditions, if it determines by a majority vote of all members of the Town Board, supported by clear and convincing evidence presented by the applicant, that the operations of the proposed CAFO, with or without conditions, will protect health (including human and animal), safety, and general welfare, prevent pollution and the creation of private nuisances and public nuisances, and preserve the quality of life, environment, and existing small-scale livestock and other agricultural operations of the Town and that the application meets all other requirements of this Ordinance.

Section 9. Financial Surety

A CAFO Operations Permit shall require the applicant and all contractors, subcontractors, agents and representatives, to ensure that sufficient funds will be available for pollution clean-up, nuisance abatement, and proper closure of the operation if it is abandoned or otherwise ceases to operate as planned and permitted, based on the following provisions:

1. A determination shall be made regarding the financial assurance level required by the scale of the operation. As a condition of the license, the required financial assurance shall be filed with the Town of Eureka in an amount sufficient to clean up environmental contamination if the same were to occur, to abate public nuisances caused by the operation, including but not limited to the testing and replacement of any potentially contaminated private and public wells and water supplies within the areas subject to operations, and to ensure proper closure of the operations should the applicant elect to close or should closure occur for some other reason. Upon notification of the required financial assurance, but prior to commencing operations, the applicant shall file with the Town the financial assurance conditioned on faithful performance of all requirements for the license. Upon notification of finance assurance or deposit approval and conformance with license conditions, the applicant may commence operations.

2. The applicant may deposit cash or irrevocable letters of credit established with a bank acceptable to the Town as the required financial assurance.

3. The Town may reevaluate and adjust accordingly the amount of the financial assurance required on an annual basis.

Section 10. Conditions of Approval

A CAFO Operations Permit may be approved with conditions to protect public health (including human and animal health), safety, and general welfare, prevent pollution and the creation of private nuisances and public nuisances, and preserve the quality of life, environment, and existing small-scale livestock and other agricultural operations of the Town. To the extent not expressly or otherwise preempted by Wis. Stat. 93.90, and Wis. Admin. Code Ch. ATCP 51 or any other provision of state or federal law, such conditions may include, but are not limited to:

1. Conditions relating to the operational characteristics of the proposed operation, to protect public health, prevent point and non-point sources of air and water pollution, and prevent private nuisances and public nuisances;

2. Conditions relating to the management of animal and other waste that may be generated as part of an operation's ongoing operation, to protect public health, prevent point and non-point sources of air and water pollution, and prevent private nuisances and public nuisances;

3. Conditions relating to the population and depopulation of individual animal housing facilities, to protect public health and prevent the spread of animal-borne and vector-borne disease, to assure a safe level of sanitation, and to assure human health hazard control or health protection for the community;

4. Conditions relating to biosecurity and the maintenance of animal health and welfare, to prevent the spread of animal-borne and vector-borne disease, to protect public health, and provide for animal safety and welfare;

5. Conditions relating to transportation of animals as part of the ongoing operations, to protect public health, prevent pollution, and prevent private nuisances and public nuisances;

6. Conditions relating to protection of private and public drinking and agricultural wells, and other public water supplies, as part of an ongoing operation to protect public health, prevent pollution, and prevent private nuisances and public nuisances;

7. Conditions relating to air emissions and dust control as part of an ongoing operation, to protect public health, prevent pollution and prevent private nuisances and public nuisances;

8. Conditions relating to protection of the private and public property rights and property values of affected property owners, as part of an ongoing operation, to protect the general welfare of the Town's residents and property owners, and to prevent private nuisances and public nuisances;

9. Conditions relating to permit compliance, enforcement and monitoring, including establishment of fees that may be assessed against the permittee to cover the costs of hiring, training, and maintaining Town personnel, or for contracting with private consultants, to conduct permit compliance, enforcement and monitoring activities for the Town.

10. Conditions relating to the monitoring of surface water, ground water, air quality and all other environmental factors and considerations.

11. Any other conditions deemed reasonably necessary or appropriate by the Town Board to effectively, efficiently, and comprehensively regulate the operations of a facility, to protect public health (including human and animal health), safety, and general welfare, prevent pollution and the creation of private nuisances and public nuisances, and preserve the quality of life, environment, and existing small-scale livestock and other agricultural operations of the Town.

These conditions may apply not only to the CAFO facility itself, but also to any property upon which manure, carcasses, body tissue or other by products of the CAFO are spread, deposited or

disposed of. Any conditions imposed under this Ordinance may be modified by the Town Board at the time of each annual renewal. Any modifications must be documented as required by section 11, below.

Section 11. Record of Decision

The Town Board must issue its decision in writing. The decision must be based on written findings of fact supported by evidence in the record.

Section 12. Transferability of License

A CAFO Operations Permit and the privileges granted by this license run with the land approved under the license and remain in effect, despite a change in ownership of the livestock facility, as long as the new operator does not violate the terms of the local approval.

Upon change of ownership of the livestock facility, the new owner of the facility shall file information with the Town Clerk providing pertinent information, including but not limited to such information as the name and address of the new owner and date of transfer of ownership.

Section 13. Expiration of License

A CAFO Operations Permit remains in effect regardless of the amount of time that elapses before the livestock operator exercises the authority granted under this permit, and regardless of whether the livestock operator exercises the full authority granted by the approval. However, the Town may treat a CAFO Operations Permit as lapsed and withdraw the license if the license holder fails to do all of the following within 2 years after issuance of license:

1. Begin populating the CAFO.

2. Begin constructing all of the new or expanded livestock housing or waste storage structures proposed in the application for local approval.

3. Pay the renewal fee on or before January 1 of each calendar year as required by Section 14 of this Ordinance.

Section 14. License Terms and Modifications

A CAFO Operations Permit and the privileges granted by a CAFO Operations Permit issued under this Ordinance is conditioned on the livestock operator's compliance with the standards in this Ordinance, and with commitments made in the application for a CAFO Operations Permit. The operator may make reasonable changes that maintain compliance with the standards in this Ordinance, and the Town Board shall not withhold authorization for those changes unless the Town can demonstrate good cause to do so. A violation of the Permit or a failure to comply with the commitments made in the application may result in suspension and/or termination of the Permit.

The Town Board, or its designee, shall work to ensure on an ongoing basis that all requirements and conditions of any permit issued under this Ordinance are followed by the permitee. To assist in accomplishing this task, any permit issued pursuant to this Ordinance shall be subject to an annual renewal fee in the amount of One Dollar ($1.00) per animal unit. Modifications to the conditions of a CAFO Operations Permit may be made as described in Sections 10 and 11.

Section 15. Penalties

Any person who violates any of the provisions of this Ordinance, or who fails, neglects or refuses to comply with the provisions of this Ordinance, or who knowingly makes any material false statement or knowing omission in any document required to be submitted under the provisions hereof, shall be subject to the following penalties:

1. Upon conviction by a court of law, pay a forfeiture of not less than $100 nor more than $1,000, plus the applicable surcharges, assessments, and costs for each violation.

2. Each day a violation exists or continues shall be considered a separate offense under this Ordinance.

3. In addition, the Town Board may seek injunctive relief from a court of record to enjoin further violations.

4. In addition, the Town Board may suspend or revoke the local approval of a CAFO Operations Permit under this Ordinance after due notice to the livestock facility owner and a public hearing to determine whether the license should be suspended or revoked.

The Town shall exercise sound judgment in deciding whether to suspend or revoke a CAFO Operations Permit. The Town shall consider extenuating circumstances, such as adverse weather conditions, that may affect an operator's ability to comply.

In addition to any other penalty imposed by this Ordinance, the cost of abatement of any public nuisance on the licensed premises by the Town may be collected under this Ordinance or Sec. 823.06 of Wis. Statutes against the owner of the real estate upon which the public nuisance exists. Such costs of abatement may be recovered against the real estate as a special charge under Sec. 66.0627 of Wis. Statutes unless paid earlier.

Section 16. Appeals

An applicant or any other person or party who is aggrieved by a final decision of the Town Board on whether to issue a CAFO Operations Permit, either with or without conditions, or a taxpayer, may, within thirty (30) days after the filing of the decision with the Town Clerk, commence an action seeking the remedy available by certiorari in Polk County Circuit Court. The court shall not stay the decision appealed from, but may, with notice to the Town Board, grant a restraining order. The Town Board shall not be required to return the original papers acted upon by it, but it shall be

sufficient to return certified or sworn copies thereof. If necessary, for the proper disposition of the matter, the court may take evidence, or appoint a referee to take evidence and report findings of fact and conclusions of law as it directs, which shall constitute a part of the proceedings upon which the determination of the court shall be made. The court may reverse or affirm, wholly or partly, or may modify, the decision brought up for review.

In any certiorari proceeding brought under the preceding paragraph, attorney fees and costs shall not be allowed against the Town Board unless it shall appear to the court that it acted with gross negligence, or in bad faith, or with malice in making the decision appealed from.

A final decision of the Town Board under this ordinance is not subject to appeal under Wis. Stat. 93.90(5), Wis. Stat 93.30, or Wis. Admin Code Ch. ATCP 51, which apply only to siting decisions.

Section 17. Severability

If any provision of this Ordinance or its application to any person or circumstance is held invalid, the invalidity does not affect other provisions or applications of this Ordinance that can be given effect without the invalid provision or application, and to that end, the provisions of this Ordinance are severable.

Section 18. Effective Date

This Ordinance is effective the day after publication.

Adopted this _____ day of _____, 2020 by the Town Board of Supervisors.

_____

Town Chairman

Attested:

_____

Town Clerk

TOWN OF EUREKA
POLK COUNTY, WISCONSIN

ORDINANCE NO. _____
CONCENTRATED ANIMAL FEEDING OPERATIONS ORDINANCE

APPENDIX A

References

1. Gomes A, Quinteiro-Filho W, Ribeiro A, et al. Overcrowding stress decreases macrophage activity and increases *Salmonella* enteritidis invasion in broiler chickens. *Avian Pathol.* 2014;43(1):82-90.
Link: https://www.ncbi.nlm.nih.gov/pubmed/24350836

This study sought to characterize the immunosuppressive effect of overcrowding stress in broiler chickens. Overcrowding was found to compromise the intestinal immune barrier and integrity of the small intestine, resulting in inflammation and decreased nutrient absorption. The study concludes that animal welfare measures and avoiding overcrowding stress factors in maintaining poultry health and decreased susceptibility to *Salmonella* infection.

2. Rostagno MH. Can stress in farm animals increase food safety risk? *Foodborne pathogens and disease.* 2009;6(7):767-776.
Link: http://online.liebertpub.com/doi/pdf/10.1089/fpd.2009.0315

This study reviewed current knowledge to assess the potential impact of stress—such as that from inadequate nutrition, deprivation of water and/or feed, heat, cold, overcrowding, handling and transport—in farm animals on food safety risk. The review focused on stress mechanisms influencing the colonization and shedding of enteric pathogens in food animals due to the potential for their dissemination into the human food chain, a serious public health and economic concern. The review concluded that there is a growing body of evidence that demonstrates the negative impact of stress on food safety through a variety of potential mechanisms, and recommends additional research to optimize animal welfare and minimize production loses and food safety risks.

3. Rule AM, Evans SL, Silbergeld EK. Food animal transport: A potential source of community exposures to health hazards from industrial farming (CAFOs). *Journal of Infection and Public Health.* 2008;1(1):33-39.
Link: https://www.ncbi.nlm.nih.gov/pubmed/20701843

The results of this study support the hypothesis that current methods of food animal transport from farm to slaughterhouse result in the transfer of bacteria, including antibiotic-resistant bacteria, to the vehicles travelling the same road. Bacteria were isolated from air and surface samples from vehicles following open poultry trucks, suggesting a new route of exposure to pathogens and the further dissemination of these pathogens to the general environment.

4. Price LB, Graham JP, Lackey LG, Roess A, Vailes R, Silbergeld E. Elevated risk of carrying gentamicin-resistant *Escherichia coli* among US poultry workers. *Environ Health Perspect.* 2007:1738-1742.
Link: https://www.ncbi.nlm.nih.gov/pubmed/18087592
Occupational and environmental pathways of human exposure to antimicrobial-resistant bacteria were explored in this study by comparing the relative risk of antimicrobial-resistant *E. coli* among poultry workers compared with community referents. The study concluded that occupational exposure to

antimicrobial-resistant bacteria may be an important route of entry for the bacteria into the community, as poultry workers had 32 times the odds of carrying resistant *E. coli* compared to the community referents.

5. Baykov B, Stoyanov M. Microbial air pollution caused by intensive broiler chicken breeding. *FEMS Microbiol Ecol.* 1999;29(4):389-392.
Link: https://academic.oup.com/femsec/article/29/4/389/527380/Microbial-air-pollution-caused-by-intensive-broiler-breeding-operations

> This study examined the extent of microbial atmospheric pollution caused by industrial broiler breeding operations and found that as birds aged, microbial numbers increased in the indoor air and were spread into the environment to a greater degree. The study also found that microorganisms could be spread by air flow up to 3000 meters from the production buildings.

6. Spencer JL, Guan J. Public health implications related to spread of pathogens in manure from livestock and poultry operations. *Public Health Microbiology: Methods and Protocols.* 2004:503-515.
Link: https://www.ncbi.nlm.nih.gov/pubmed/15156064

> Objectionable odors, flies, excessive levels of nitrogen and phosphorus and the potential spread of human pathogens are among the public concerns with the disposal of animal manure and the spread of dust and manure blown from powerful building fans. The study also finds that importance of animal manure in the spread of infectious pathogens is often underestimated despite the linkages between livestock operations and gastroenteritis in humans.

7. Graham JP, Leibler JH, Price LB, et al. The animal-human interface and infectious disease in industrial food animal production: Rethinking biosecurity and biocontainment. *Public Health Rep.* 2008:282-299. Link: https://www.ncbi.nlm.nih.gov/pubmed/19006971

> The transition of food animal production from small-scale methods to industrial-scale operations has been accompanied by substantial evidence of the transfer of pathogens between and among industrial food animal facilities, the environment, and exposure to farm workers. This challenges the notion that modem animal production is more biosecure than smaller operations in regards to the introduction and release of pathogens. The study concludes that industrialized food animal production risk factors must be included in strategies to mitigate or prevent the emergence of pandemic avian influenza.
> *Refer to page 17 of this document for the complete article abstract.*

8. Jahne MA, Rogers SW, Holsen TM, Grimberg SJ, Ramler IP. Emission and dispersion of bioaerosols from dairy manure application sites: Human health risk assessment. *Environ Sci Technol.* 2015 ;49(16):9842-9849 .
Link: https://www.ncbi.nlm.nih.gov/pubmed/26158489

> The risk of human gastrointestinal infection associated with exposure to airborne pathogens following the land application of dairy manure was explored in this study. It was concluded that bioaerosol emissions from manure application sites may present significant public health risks to downwind receptors, and improved manure management practices that include better controls for bioaerosols were recommended to reduce the risk of disease transmission.
> *Refer to page 12 of this document for the complete article abstract.*

9. Casey JA, Curriero FC, Cosgrove SE, Nachman KE, Schwartz BS. High-density livestock operations, crop field application of manure, and risk of community-associated methicillin-resistant *Staphylococcus aureus* infection in Pennsylvania. *JAMA Internal Medicine.* 2013;173(21):1980-1990.
Link: https://www .ncbi .nlm .nih .gov/pubmed/24043228

This study assessed the association between exposure to swine and dairy/veal industrial agriculture and the risk of methicillin-resistant *Staphylococcus aureus* (MRSA) infection. The study found that proximity to livestock operations and crop fields treated with swine manure were each associated with MRSA, skin and soft-tissue infection.
Refer to page 16 of this document for the complete article abstract.

10. Roberts RR, Hota B, Ahmad **I,** et al. Hospital and societal costs of antimicrobial-resistant infections in a Chicago teaching hospital: Implications for antibiotic stewardship. *Clin Infect Dis.* 2009;49(8):11751184.
Link: https://academic.oup.com/cid/article/49/8/1175/425330/Hospital-and-Societal-Costs-of-Antimicrobial

Medical and societal costs attributable to antimicrobial-resistant infections are considerable, and important factors in understanding the potential benefits of prevention programs. Medical costs attributable to antimicrobial-resistant infections range from $18,588 to $29,069 per patient, hospital stay durations from 6.4-12.7 days, and mortality of 6.5%. Societal costs were estimated at $10.7-$15 million.

11. Filice GA, Nyman JA, Lexau C, et al. Excess costs and utilization associated with methicillin resistance for patients with *Staphylococcus aureus* infection. *Infection Control & Hospital Epidemiology.* 2010;31(04):365-373.
Link: https://www.ncbi.nlm.nih.gov/pubmed/20184420

Healthcare costs of methicillin-resistant *S. aureus* (MRSA) infections and methicillin-susceptible *S. aureus* (MSSA) were compared in this study. MRSA infections were found to be independently associated with higher costs, more comorbidities, and higher likelihood of death than MSSA infections.

12. Price LB, Lackey LG, Vailes R, Silbergeld E. The persistence of fluoroquinolone-resistant *Campylobacter* in poultry production. *Environ Health Perspect.* 2007:1035-1039.
Link: https://www.ncbi.nlm.nih.gov/pmc/articles/F'MC1913601/

Halting fluoroquinolone use was not found to have an impact on the proportion of fluoroquinolone-resistant *Campylobacter* on products from the conventional producers, indicating that antibiotic-resistant bacteria may persistently contaminate poultry products even after on-farm use of the antibiotic has ceased. Also, *Campylobacter* strains from the conventional producers were more likely to be resistant to fluoroquinolone than those from the antibiotic-free producers, indicating that antibiotic use in food animal production contributes to the develop of antibiotic-resistant pathogens.

13. Schulz J, Friese A, Klees S, et al. Longitudinal study of the contamination of air and of soil surfaces in the vicinity of pig barns by livestock-associated methicillin-resistant *Staphylococcus aureus. Appl Environ Microbiol.* 2012;78(16):5666-5671.
Link: https://www .ncbi .nlm .nih .gov/pubmed/22685139

This study examined the presence and concentration of MRSA in air and soil downwind from swine CAFOs. The results demonstrate regular transmission and deposition of airborne livestock-associated MRSA to areas up to at least 300 meters around pig barns that tested positive for MRSA, suggesting that swine CAFOs can expose other farm animals, wildlife, and people to MRSA.
Refer to page 21 of this document for the complete article abstract.

14. Burgos J, Ellington B, Varela M. Presence of multidrug-resistant enteric bacteria in dairy farm topsoil. *J Dairy Sci.* 2005;88(4):1391-1398.
Link: https://www.ncbi.nlm.nih.gov/pubmed/15778307

This study was conducted to better understand how widespread antibiotic-resistant bacteria are in agricultural settings, particularly in dairy farm environments. The study concluded that dairy farm topsoil contains multidrug resistant enteric bacteria and antibiotic-resistant plasmids, and suggests that dairy topsoils serve as a reservoir for the development of bacterial resistance to antibiotics relevant in clinical medicine.
Refer to page 12 of this document for the complete article abstract.

15. Sapkota AR, Curriero FC, Gibson KE, Schwab KJ. Antibiotic-resistant enterococci and fecal indicators in surface water and groundwater impacted by a concentrated swine feeding operation. *Environ Health Perspect.* 2007:1040-1045.
Link: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1913567/

Surface and groundwater located up and down gradient from a swine facility was analyzed for the presence of antibiotic-resistant enterococci and other fecal indicators in this study. Both were detected at elevated levels in down gradient water sources relative to the swine facility compared to up-gradient sources, providing evidence that water contaminated with swine manure can contribute to the spread of antibiotic resistance.
Refer to page 20 of this document for the complete article abstract.

16. Graham JP, Evans SL, Price LB, Silbergeld EK. Fate of antimicrobial-resistant enterococci and staphylococci and resistance determinants in stored poultry litter. *Environ Res.* 2009;109(6):682-689.
Link: https://www .ncbi.nlm.nih .gov/pubmed/19541298

This study examined the survival of anti-microbial resistant enterococci and staphylococci and resistance genes in poultry litter to better understand how land application of poultry litter can affect the surrounding populations environment. The study found that poultry litter storage practices do not eliminate drug-resistant bacterial strains, thus allowing the spread of these drug-resistant pathogens into and through the environment via land application of poultry litter.

17. United States Environmental Protection Agency. Literature review of contaminants in livestock and poultry manure and implications for water quality. July 2013:1-137.
Link: http://ow.ly/mTDw308qwbZ

This EPA report on the environmental occurrence and potential effects of livestock and poultry manure related contaminants on water quality found that 60-70% of manure nitrogen and phosphorus may not be assimilated by the farmland where it was generated due to the increasing concentration of industrial animal production. The report also notes the variety of pathogens contained in livestock and poultry manure, as well as the potential for their spread to humans when surface and groundwater and food crops come into contact with manure through runoff, spills, and land-application of manure. It also refers to research indicating that antimicrobial use in livestock and poultry production has contributed to the occurrence of anti-microbial resistant pathogens in animal operations and nearby environments. The report also presents that manure discharge to surface waters can occur by various means and have deleterious effects on aquatic

life and contribute to toxic algal blooms harmful to animals, and to humans when exposed via contact with contaminated drinking water or recreational use of contaminated water.

18. Wichmann F, Udikovic-Kolic N, Andrew S, Handelsman J. Diverse antibiotic resistance genes in dairy cow manure. *MBio.* 2014;5(2):e01017-13.
Link: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3993861/

This study was conducted to better understand the cow microbiome and the role of the land application of cow manure in the spread of antibiotic resistance. The study reports the discovery of new and diverse antibiotic resistant genes in the cow microbiome, and provides evidence that it is a significant reservoir of antibiotic resistant genes.
Refer to page 14 of this document for the complete article abstract.

19. Graham JP, Price LB, Evans SL, Graczyk TK, Silbergeld EK. Antibiotic resistant enterococci and staphylococci isolated from flies collected near confined poultry feeding operations. *Sci Total Environ.* 2009;407(8):2701-2710.
Link: https://www.ncbi.nlm.nih.gov/pubmed/19157515

This study examined if and how antibiotic resistant bacteria are transferred from poultry operations to nearby communities, and found that flies caught near poultry operations carried the same drug-resistant pathogens as those found in poultry litter. The study concludes that flies may be an important vector in the spread of drug resistant bacteria from poultry operations and may increase human exposure to these resistant pathogens.

20. Heaney CD, Myers K, Wing S, Hall D, Baron D, Stewart JR. Source tracking swine fecal waste in surface water proximal to swine concentrated animal feeding operations. *Sci Total Environ.* 2015;511:676-683.
Link: https ://www .ncbi.nlm.nih .gov/pubmed/25600418

The microbial quality of surface water proximal to swine CAFOs was investigated in this study to better understand the impact of CAFOs on the surrounding environment. The results demonstrate overall poor water quality in areas with a high density of swine CAFOs, with high fecal indicator bacteria concentrations in waters both up- and down-stream of CAFO lagoon waste land application sites. The swine-specific microbial source tracking markers used in the study were also shown to be useful for tracking off-site conveyance of swine fecal wastes and during rain events.
Refer to page 17 of this document for the complete article abstract.

21. United States Geological Survey (USGS). USGS water use data for the nation. http://waterdata.usgs.gov/nwis/wu. Updated June 8,2016. Accessed January 31,2017.

This United States Geological Survey website provides national water use data by area type (aquifer, watershed, county, state), source (rivers or groundwater), and category such as irrigation or public supply.

22. Heederik D, Sigsgaard T, Thorne PS, et al. Health effects of airborne exposures from concentrated animal feeding operations. *Environ Health Perspect.* 2007:298-302.
Link: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1817709/

This report from a Conference on Environmental Health Impacts of Concentrated Animal Feeding Operations: Anticipating Hazards —Searching for Solutions working group states that toxic gases, vapors and particles are emitted from CAFOs into the general environment, and that while these agents are known to be harmful to human health, there are few studies that explore the health risks of exposure to these agents for the people living near CAFOs. While there is evidence that psychophysiologic changes may result from exposure to malodors and that microbial exposures are related to deleterious respiratory health effects, the working group concluded that there is great need to study and evaluate the health effects of community exposure to these CAFO related air pollutants to better understand the impact of CAFOs on the health of community members and farm workers.

23. Cambra-Lopez M, Aarnink AJ, Zhao Y, Calvet S, Tones AG. Airborne particulate matter from livestock production systems: A review of an air pollution problem. *Environmental Pollution.* 2010;158(1):1-17.
Link: https://www.ncbi.nlm.nih.gov/pubmed/19656601

This paper reviews research on particulate matter inside and emitted from livestock production system and reports that livestock housing is an important source of particulate matter emissions. The paper recommends additional research to characterize and control particulate matter in livestock houses, as high concentrations such as those found in livestock houses can threaten the environment and the health and welfare of humans and animals.

24. Mirabelli MC, Wing S, Marshall SW, Wilcosky TC. Asthma symptoms among adolescents who attend public schools that are located near confined swine feeding operations. *Pediatrics.* 2006;118(1):e66-75.
Link: http://pediatrics .aappublications .org/content/118/1/e66

The relationship between exposure to airborne effluent from swine CAFOs and asthma symptoms in adolescents age 12-14 years old was assessed in this study to better understand the health effects of living near industrial swine facilities. The study found that estimated exposure to swine CAFO air-pollution was associated with wheezing symptoms in adolescents.
Refer to page 19 of this document for the complete article abstract.

25. Schinasi L, Horton RA, Guidry VT, Wing S, Marshall SW, Morland KB. Air pollution, lung function, and physical symptoms in communities near concentrated swine feeding operations. *Epidemiology.* 2011 ;22(2):208-215 .
Link: https://www .ncbi .nlm .nih .gov/pubmed/21228696

This study examined the associations between reported malodor and monitored air pollutants with lung function and physical symptoms in people residing within 1.5 miles of hog operations to better understand the effect of CAFO air pollutants on human health. The study reported that acute physical symptoms, including eye irritation, respiratory symptoms, difficulty breathing, wheezing, declined forced expiratory volume, sore throat, chest tightness, and nausea were related to pollutants measured near hog operations.
Refer to page 21 of this document for the complete article abstract.

26. Hribar C, Schultz M. Understanding concentrated animal feeding operations and their impact on communities. *Bowling Green, **OH:** National Association of Local Boards of Health.* 2010.
Link: https://www.cdc.gov/nceh/ehs/docs/understanding_cafos_nalboh.pdf

The National Association of Local Boards of Health produced this report with the support of the Centers for Disease Control and Prevention and the National Center for Environmental Health to assist local board of health members better understand their role in mitigating potential issues with CAFOs. The report concludes that large-scale industrial food animal production can cause numerous public health and environmental problems and should thus be monitored to prevent harm to surrounding communities. Suggested actions include passing ordinances and regulations, and increasing water and air quality monitoring and testing. The report also concludes that local boards of health, in collaboration with state and local agencies, are an appropriate body for instituting these actions due to the local nature of CAFO concerns and risks.

27. Donham KJ, Wing S, Osterberg D, et al. Community health and socioeconomic issues surrounding concentrated animal feeding operations. *Environ Health Perspect.* 2007:317-320.
Link: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1817697/

The Workgroup on Community and Socioeconomic Issues examined the impacts of CAFOs on the health of rural communities, using the World Health Organization's definition of health, "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." The workgroup recommended more stringent CAFO permitting, limiting animal density per watershed, improving local control, mandating environmental impact statements and considering bonding for manure storage basins.
Refer to page 16 of this document for the complete article abstract.

28. Wing S, Wolf S. Intensive livestock operations, health, and quality of life among eastern North Carolina residents. *Environ Health Perspect.* 2000;108(3):233-238.
Link: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1637983/

Reports of decreased health and quality of life from people who live near industrial animal operations were explored in this study through community surveys in three rural communities, one located near a large swine operation, one near two intensive cattle operations, and one area without nearby livestock operations using liquid waste management systems. Residents near the swine operation reported increased occurrences of poor health, such as headaches, diarrhea, sore throat, excessive coughing and burning eyes and reduced quality of life compared to those in the other two communities.

29. Horton RA, Wing S, Marshall SW, Brownley KA. Malodor as a trigger of stress and negative mood in neighbors of industrial hog operations. Am *J Public Health.* 2009;99(S3):S610-S615.
Link: https://www.ncbi.nlm.nih.gov/pubmed/19890165

The association between malodor and air pollutants from nearby hog CAFOs and reported stress and negative mood was evaluated in this study to better understand the role of CAFOs in human health. The study found that malodor and air pollutants acted as environmental stressors and triggers of negative mood and recommended their inclusion in studies of the health impacts of environmental injustice.
Refer to page 18 of this document for the complete article abstract.

30. Wing S, Horton RA, Rose KM. Air pollution from industrial swine operations and blood pressure of neighboring residents. *Environmental Health Perspectives (Online).* 2013;121(1):92.
Link: https://ehp.niehs.nih.gov/1205109/

The association of air pollution and malodor with stress and blood pressure were assessed in this study to improve understanding of the effects of industrial swine operations on human health. Malodor and some air pollutants were found to be associated with blood pressure increases and reported stress, which could contribute to the development of chronic hypertension.
Refer to page 22 of this document for the complete article abstract.

31. Graham JP, Nachman KE. Managing waste from confined animal feeding operations in the United States: The need for sanitary reform. *Journal of Water and Health.* 2010;8(4):646-670.
Link: https://www.ncbi.nlm.nih.gov/pubmed/20705978

Trends affecting food animal waste production, risks associated with food-animal wastes, and differences between food-animal waste and human biosolid management practices were examined in this study. The study found that no standards exist for the 335 million tons of food animal waste applied to land in the US, while human biosolids, which make up just 1% of all land-applied wastes, are subject to standards. Hormones, arsenicals, high nutrient loads, antibiotics, and pathogens, including antibiotic-resistant pathogens, are often present in animal waste. The authors made recommendations for improving management of food-animal waste through existing and new policies.

32. Showers WJ, Genna B, McDade T, Bolich R, Fountain JC. Nitrate contamination in groundwater on an urbanized dairy farm. *Environ Sci Technol.* 2008;42(13):4683-4688.
Link: https://www.ncbi.nlm.nih.gov/pubmed/18677991

This study sought to identify sources of drinking water well nitrate contamination in a housing development built on a dairy farm site using isotopic compositions of nitrate, ammonia, groundwater and chemical ratios. The results indicate that the elevated nitrate levels were due to the leaching of animal waste from pastures into groundwater during the 35 years of dairy operations. The study suggests enacting statutes requiring well water tests prior to the sale of homes built on urbanized farmland to protect the health of homeowners.
Refer to page 13 of this document for the complete article abstract.

33. Relation between nitrates in water wells and potential sources in the lower Yakima Valley, Washington state. U.S. Environmental Protection Agency, Washington, D.C., 2012. Link: Https://Www3.epa.gov/region10/pdf/sites/yakimagw/nitrate_in_water_wells_study_9-27-2012.pdf.

This study examined the effectiveness of various techniques to identify specific sources of high nitrate levels in residential drinking water well. Dairy waste was concluded to be a likely source of nitrate contamination in the wells due to isotopic data and contextual evidence such as the historical and current volumes of dairy waste in the area, lack of other potential sources of nitrogen in the area, and soil indicators.
For more detail on this report, refer to page 14 of this document.

34. Burkholder J, Libra B, Weyer P, et al. Impacts of waste from concentrated animal feeding operations on water quality. *Environ Health Perspect.* 2007:308-312.
Link: https://www.ncbi.nlm.nih.gov/pmc/articles/F'MC1817674/

This work-group, part of the Conference on Environmental Health Impacts of Concentrated Animal Feeding Operations: Anticipating Hazards—Searching for Solutions, found that current and generally accepted livestock waste management practices do not protect water resources from the pathogens, pharmaceuticals and excessive nutrients found in animal waste. As concern about

the potential human and environmental health impact of long-term exposure to contaminated water grows, there is greater need for rigorous monitoring of CAFOs, improved understanding of the major toxicants affecting human and environmental health, and a system to enforce these practices.

35. Ward MH. Too much of a good thing? Nitrate from nitrogen fertilizers and cancer. *Rev Environ Health.* 2009;24(4):357-363.
Link: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3068045/

Nitrate, the breakdown product of nitrogen fertilizers, accumulates in groundwater under agricultural land and can spread through waterways due to agricultural field runoff. Nitrates are associated with a range of adverse health effects, including methemoglobinemia, various cancers, negative reproductive outcomes, diabetes, and thyroid conditions. Additional research is needed to further evaluate the health effects of nitrate exposure, especially as environmental exposure to nitrates has increased over the last 50 years and 90% of rural Americans depend on groundwater for drinking water, many relying on private wells, which are not regulated by the Safe Drinking Water Act.

36. Chiu H, Tsai S, Yang C. Nitrate in drinking water and risk of death from bladder cancer: An ecological case-control study in Taiwan. *Journal of Toxicology and Environmental Health, Part A.* 2007;70(12):1000-1004.
Link: https://www.ncbi.nlm.nih.gov/pubmed/17497410

The association between bladder cancer mortality and nitrate exposure from Taiwan drinking water was investigated in this study. The results showed a significant positive relationship between the levels of nitrates in the drinking water and the risk of death from bladder cancer, indicating that environmental exposure to nitrates plays a role in the development of bladder cancer.

37. Ward MH, Kilfoy BA, Weyer PJ, Anderson KE, Folsom AR, Cerhan JR. Nitrate intake and the risk of thyroid cancer and thyroid disease. *Epidemiology.* 2010;21(3):389-395.
Link: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2879161/

This study examined the association between nitrate intake through public water and diet with the risk of thyroid cancer and hypo- and hyperthyroidism. The study found an increased risk of thyroid cancer with high water nitrate levels and with longer consumption of water containing nitrates. The increased intake of dietary nitrate was associated with an increased risk of thyroid cancer, and with the prevalence of hypothyroidism.

38. Gulis G, Czompolyova M, Cerhan JR. An ecologic study of nitrate in municipal drinking water and cancer incidence in Trnava district, Slovakia. *Environ Res.* 2002;88(3):182-187.
Link: https://www.ncbi.nlm.nih.gov/pubmed/12051796

This ecologic study was conducted to assess the association between nitrate levels in drinking water with non-Hodgkin lymphoma and cancers of the digestive and urinary tracts in an agricultural district. The study found is that a higher incidence of some cancers was associated with higher levels of nitrate in drinking water. The trend was found in women for overall cancer cases, stomach cancer, colorectal cancer and non-Hodgkin lymphoma, and in men for non-Hodgkin lymphoma and colorectal cancer.

39. Manassaram DM, Backer LC, Moll DM. A review of nitrates in drinking water: Maternal exposure and adverse reproductive and developmental outcomes. *Environmental Health Perspectives.* 2006.
Link: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1392223/

The relationship between maternal exposure to nitrates through drinking water and adverse reproductive and developmental outcomes was reviewed in this study. Animal studies support the association between nitrate exposure and adverse reproductive effects, and some studies report an association between nitrates in drinking water and spontaneous abortion, intrauterine growth restriction and various birth defects, though a direct exposure-response relationship remains unclear and there is insufficient evidence to establish a causal relationship.

40. Brender JD, Weyer PJ, Romitti PA, et al. Prenatal nitrate intake from drinking water and selected birth defects in offspring of participants in the national birth defects prevention study. *Environ Health Perspect.* 2013;121(9):1083-1089.
Link: https://www.ncbi.nlm.nih.gov/pubmed/23771435

The relationship between prenatal exposure to nitrates in drinking water and birth defects was examined in this study. The study concluded that higher maternal water nitrate consumption was associated with birth defects, including spina bifida, limb deficiency, cleft palate, and cleft lip.

41. Knobeloch L, Salna B, Hogan A, Postle J, Anderson H. Blue babies and nitrate-contaminated well water. *Environ Health Perspect.* 2000;108(7):675-678.
Link: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1638204/

Two cases of infant methemoglobinemia associated with nitrate contaminated private well water were described in this paper. The case studies underscore the danger that this contaminated water poses to infants during the first six months of life, as well as the risks of long-term exposure, which include cancer, thyroid disease and diabetes. Steps to reduce nitrate inputs in groundwater and routine well water testing are recommended to protect health.

42. Heisler J, Glibert PM, Burkholder JM, et al. Eutrophication and harmful algal blooms: A scientific consensus. *Harmful Algae.* 2008;8(1):3-13.
Link: http://www.sciencedirect.com/science/article/pii/S1568988308001066

The US EPA held a roundtable discussion to develop consensus among academic, federal and state agency representatives on the relationship between eutrophication and harmful algal blooms. Seven statements were adopted during the session, which include acknowledgement of the important role of nutrient pollution and degraded water quality in the development and persistence of many harmful algal blooms.

43. Carmichael WW. Health effects of toxin-producing cyanobacteria: "The CyanoHABs". *Human and Ecological Risk Assessment: An International Journal.* 2001;7(5):1393-1407.
Link: http://www.tandfonline.com/doi/abs/10.1080/20018091095087

Current understandings of cyanobacteria toxin poisonings (CTPs) and their risk to human health were reviewed in this paper. CTPs occur in fresh and brackish waters throughout the world as a result of eutrophication and climate change. Cyanobacteria toxins are responsible for acute lethal, acute, chronic and sub-chronic poisonings of wild and domestic animals and humans. These poisonings result in respiratory and allergic reactions, gastrointestinal disturbances, acute hepatotoxicosis and peracute neurotoxicosis.

44. Paerl FIW, Fulton RS ,3rd, Moisander PH, Dyble J. Harmful freshwater algal blooms, with an emphasis on cyanobacteria. *Scientific World Journal.* 2001;1:76-113.

This paper reviews the effects of harmful freshwater algal blooms, resulting from nutrient oversupply and eutrophication, on water quality. Algal blooms contribute to water quality degradation, including malodor and foul taste, fish kills, toxicity, and food web alterations, while algal bloom toxins can adversely affect human and animal health through exposure to contaminated recreational and drinking water. The control and management of blooms, and their negative outcomes, must include nutrient input constraints, particularly on nitrogen and phosphorus.

45. Fry JP, Laestadius LI, Grechis C, Nachman KE, Neff RA. Investigating the role of state and local health departments in addressing public health concerns related to industrial food animal production sites. *PloS one.* 2013;8(1):e54720.
Link: http://j ournals .plos .org/plosone/article?id=10 .1371/j ournal .pone .0054720

The role of local and state health departments in responding to and preventing community concerns with industrial food animal production are explored in this study through qualitative interviews with state and county health department staff and community members in eight states. Political barriers, lack of jurisdiction, and limited resources, expertise and staff all limit health departments' ability to respond to IFAP concerns, while community members reported difficulty in engaging with health departments. These limitations and difficulties contribute to limited health department engagement on these issues.

46. Fry JP, Laestadius LI, Grechis C, Nachman KE, Neff RA. Investigating the role of state permitting and agriculture agencies in addressing public health concerns related to industrial food animal production. *PloS one.* 2014;9(2):e89870.
Link: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0089870

This study explored how state permitting and agriculture agencies respond to environmental public health concerns regarding industrial food animal production through qualitative interviews with state agency staff in seven states. The study found that the agencies were unable to adequately address these environmental public health concerns due to narrow regulations, limited resources and a lack of public health expertise. When these constraints are considered alongside those faced by health departments, significant gaps in the ability to respond to and prevent public health concerns and issues are revealed.

Research Articles Related to Dairy Production

Burgos, J. M., B. A. Ellington, and M. F. Varela. "Presence of multidrug-resistant enteric bacteria in dairy farm topsoil." *Journal of Dairy Science* 88.4 (2005): 1391-1398.
Link: https://www.ncbi.nlm.nih.gov/pubmed/15778307

> In addition to human and veterinary medicine, antibiotics are extensively used in agricultural settings, such as for treatment of infections, growth enhancement, and prophylaxis in food animals, leading to selection of drug and multidrug-resistant bacteria. To help circumvent the problem of bacterial antibiotic resistance, it is first necessary to understand the scope of the problem. However, it is not fully understood how widespread antibiotic-resistant bacteria are in agricultural settings. The lack of such surveillance data is especially evident in dairy farm environments, such as soil. It is also unknown to what extent various physiological modulators, such as salicylate, a component of aspirin and known model modulator of multiple antibiotic resistance (mar) genes, influence bacterial multi-drug resistance. We isolated and identified enteric soil bacteria from local dairy farms within Roosevelt County, NM, determined the resistance profiles to antibiotics associated with mar, such as chloramphenicol, nalidixic acid, penicillin G, and tetracycline. We then purified and characterized plasmid DNA and detected mar phenotypic activity. The minimal inhibitory concentrations (MIC) of antibiotics for the isolates ranged from 6 to >50 microg/mL for chloramphenicol, 2 to 8 microg/mL for nalidixic acid, 25 to >300 microg/mL for penicillin G, and 1 to >80 microg/mL for tetracycline. On the other hand, many of the isolates had significantly enhanced MIC for the same antibiotics in the presence of 5 mM salicylate. Plasmid DNA extracted from 12 randomly chosen isolates ranged in size from 6 to 12.5 kb and, in several cases, conferred resistance to chloramphenicol and penicillin G. It is concluded that enteric bacteria from dairy farm topsoil are multidrug resistant and harbor antibiotic-resistance plasmids. A role for dairy topsoil in zoonoses is suggested, implicating this environment as a reservoir for development of bacterial resistance against clinically relevant antibiotics.

Jahne, Michael A., et al. "Emission and Dispersion of Bioaerosols from Dairy Manure Application Sites: Human Health Risk Assessment." *Environmental Science & Technology* 49.16 (2015): 9842-9849. Link: http://pubs.acs.org/doi/pdfplus/10.1021/acs.est.5b01981

> In this study, we report the human health risk of gastrointestinal infection associated with inhalation exposure to airborne zoonotic pathogens emitted following application of dairy cattle manure to land. Inverse dispersion modeling with the USEPA's AERMOD dispersion model was used to determine bioaerosol emission rates based on edge-of-field bioaerosol and source material samples analyzed by real-time quantitative polymerase chain reaction (qPCR). Bioaerosol emissions and transport simulated with AERMOD, previously reported viable manure pathogen contents, relevant exposure pathways, and pathogen-specific dose-response relationships were then used to estimate potential downwind risks with a quantitative microbial risk assessment (QMRA) approach. Median 8-h infection risks decreased exponentially with distance from a median of 1:2700 at edge-of-field to 1:13 000 at 100 m and 1:200 000 at 1000 m; peak risks were considerably greater (1:33, 1:170, and 1:2500, respectively). These results indicate that bioaerosols emitted from manure application sites following manure application may present significant public health risks to downwind receptors. Manure management

practices should consider improved controls for bioaerosols in order to reduce the risk of disease transmission.

Schmalzried, Hans D., and L. Fleming Fallon Jr. "Proposed Mega-Dairies and Quality-of-Life Concerns: Using Public Health Practices to Engage Neighbors." *Public Health Reports* 125.5 (2010): 754.
Link: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2925014/

This article describes the steps taken by the Henry County Health Department (Ohio) to engage with concerned community members by collaborating in baseline data collection prior to the arrival of a large-scale dairy operation. Data collection included water quality testing of residential wells neighboring the dairy operation, a fly trapping and counting program, and a review of local property values. As a dairy with 690 cows will have average water requirements of 35,000 gallons/day, the Health Department coordinated a pumping test to assess groundwater levels and found that groundwater volumes were sufficient to supply the needs of the dairy and the surrounding residential wells. Residential wells were tested for coliform bacteria and field-tested for nitrates and hydrogen sulfide gas, and some of the wells tested unsafe for bacteria. In these cases, homeowners were given instructions on how to disinfect their wells and advised to do follow-up testing. The narrative concludes that data obtained prior to operations can be very useful and that local health departments can work with neighbors and facility operators to ensure that appropriate preventive measures are in place before operation to protect the public.

Showers, William J., et al. "Nitrate contamination in groundwater on an urbanized dairy farm." *Environmental Science & Technology* 42.13 (2008): 4683-4688.
Link: http://pubs.acs.org/doi/ful1/10.1021/es071551t

Urbanization of rural farmland is a pervasive trend around the globe, and maintaining and protecting adequate water supplies in suburban areas is a growing problem. Identification of the sources of groundwater contamination in urbanized areas is problematic but will become important in areas of rapid population growth and development. The isotopic composition of NO3(815NNO3 and M80 NO3), NH4 (815NNH4), groundwater (62Hwt and 8180wt) and chloride/bromide ratios were used to determine the source of nitrate contamination in drinking water wells in a housing development that was built on the site of a dairy farm in the North Carolina Piedmont, U.S. The 615NNO3 and 6180 NO3 compositions imply that elevated nitrate levels at this site in drinking well water are the result of waste contamination, and that denitrification has not significantly attenuated the groundwater nitrate concentrations. 615NNO3 and 6180NO3compositions in groundwater could not differentiate between septic effluent and animal waste contamination. Chloride/bromide ratios in the most contaminated drinking water wells were similar to ratios found in animal waste application fields and were higher than Cl/Br ratios observed in septic drain fields in the area. 6180wt was depleted near the site of a buried waste lagoon without an accompanying shift in 62Hwt suggesting water oxygen exchange with CO2. This water—0O2 exchange resulted from the reduction of buried lagoon organic matter, and oxidation of the released gases in aerobic soils. 6180wt is not depleted in the contaminated drinking water wells, indicating that the buried dairy lagoon is not a source of waste contamination. The isotope and Cl/Br ratios indicate that nitrate contamination in these drinking wells are not from septic systems, but are the result of animal waste leached from pastures into groundwater during 35 years of dairy operations which

did not violate any existing regulations. Statutes need to be enacted to protect the health of the homeowners that require well water to be tested prior to the sale of homes built on urbanized farmland.

Wichmann, Fabienne, et al. "Diverse antibiotic resistance genes in dairy cow manure." *MBio* 5.2 (2014): e01017-13.
Link: http://mbio.asm.org/content/5/2/e01017-13.short

Application of manure from antibiotic-treated animals to crops facilitates the dissemination of antibiotic resistance determinants into the environment. However, our knowledge of the identity, diversity, and patterns of distribution of these antibiotic resistance determinants remains limited. We used a new combination of methods to examine the resistome of dairy cow manure, a common soil amendment. Metagenomic libraries constructed with DNA extracted from manure were screened for resistance to beta-lactams, phenicols, aminoglycosides, and tetracyclines. Functional screening of fosmid and small-insert libraries identified 80 different antibiotic resistance genes whose deduced protein sequences were on average 50 to 60% identical to sequences deposited in GenBank. The resistance genes were frequently found in clusters and originated from a taxonomically diverse set of species, suggesting that some microorganisms in manure harbor multiple resistance genes. Furthermore, amid the great genetic diversity in manure, we discovered a novel Glade of chloramphenicol acetyltransferases. Our study combined functional metagenomics with third-generation PacBio sequencing to significantly extend the roster of functional antibiotic resistance genes found in animal gut bacteria, providing a particularly broad resource for understanding the origins and dispersal of antibiotic resistance genes in agriculture and clinical settings. The increasing prevalence of antibiotic resistance among bacteria is one of the most intractable challenges in 21st-century public health. The origins of resistance are complex, and a better understanding of the impacts of antibiotics used on farms would produce a more robust platform for public policy. Microbiomes of farm animals are reservoirs of antibiotic resistance genes, which may affect distribution of antibiotic resistance genes in human pathogens. Previous studies have focused on antibiotic resistance genes in manures of animals subjected to intensive antibiotic use, such as pigs and chickens. Cow manure has received less attention, although it is commonly used in crop production. Here, we report the discovery of novel and diverse antibiotic resistance genes in the cow microbiome, demonstrating that it is a significant reservoir of antibiotic resistance genes. The genomic resource presented here lays the groundwork for understanding the dispersal of antibiotic resistance from the agroecosystem to other settings.

Relation between Nitrates in Water Wells and Potential Sources in the Lower Yakima Valley, Washington State. U.S. Environmental Protection Agency, Washington, D.C., 2012.
Link: https://www3.epa.gov/region10/pdf/sites/yakimagw/nitrate in water wells study 9-27-2012.pdf

Several investigations relating to nitrate contamination in the Lower Yakima Valley in Washington State have shown nitrate levels in drinking water above the U.S. Environmental Protection Agency (EPA) maximum contaminant level (MCL) of 10 mg/L. From February through April 2010, EPA conducted sampling of drinking water wells and potential sources of nitrate contamination in the Lower

Yakima Valley, in central Washington State. This report presents the results of these sampling efforts. EPA collected over 331 samples from residential drinking water wells for nitrate and bacteria, and multi-parameter sampling on 29 water wells (26 residential drinking water wells and three dairy supply wells), 12 dairy lagoons (15 samples), 11 soil samples (five at dairy application fields and six at irrigated and fertilized crop fields), five dairy manure pile samples, and three wastewater treatment plant (WWTP) influent samples. EPA's data provide some indication of the likely nitrate sources for seven of the 25 residential wells tested--animal waste was determined to be the source for six of the wells, and synthetic fertilizer the source for one of the wells. Given the historic and current volumes of wastes generated and stored by dairies, and the application of nitrogen-rich fertilizers including dairy waste in the Lower Yakima Valley, it is expected that dairies are a likely source of high nitrate levels in downgradient drinking water wells. The total nitrogen, major ions, alkalinity and barium data provide strong evidence that the dairies evaluated in this study are likely sources of the high nitrate levels in the drinking water wells downgradient of the dairies. Additional information that supports this conclusion includes: there are few potential sources of nitrogen located upgradient of the dairies; the dairy lagoons are likely leaking large quantities of nitrogen-rich liquid into the subsurface; and Washington State Department of Agriculture inspectors have reported elevated levels of nitrogen in application fields of the dairies in the study. Evaluating actions to reduce nitrate concentrations in residential drinking water wells was beyond the scope of the EPA's report. EPA concluded that actions to reduce nitrate levels are needed, although it may take many years to reduce nitrates in residential drinking water wells to safe levels because of the extent of the nitrate contamination in the Lower Yakima Valley and the persistence of nitrate in the environment.

Research Articles Related to Swine Production

Casey JA, Curriero FC, Cosgrove SE, Nachman ICE, Schwartz BS. High-Density Livestock Operations, Crop Field Application of Manure, and Risk of Community-Associated Methicillin-Resistant *Staphylococcus aureus* Infection in Pennsylvania. JAMA Intern Med. 2013 Sep 16; 21205(21):1980-90.
Link: https://www.ncbi.nlm.nih.gov/pubmed/24043228

> Nearly 80% of antibiotics in the United States are sold for use in livestock feeds. The manure produced by these animals contains antibiotic-resistant bacteria, resistance genes, and antibiotics and is subsequently applied to crop fields, where it may put community members at risk for antibiotic-resistant infections. The objective of this study was to assess the association between individual exposure to swine and dairy/veal industrial agriculture and risk of methicillin-resistant *Staphylococcus aureus* (MRSA) infection. This study was a population-based, nested case-control study of primary care patients from a single health care system in Pennsylvania from 2005 to 2010. Incident MRSA cases were identified using electronic health records, classified as community-associated MRSA or health care—associated MRSA, and frequency matched to randomly selected controls and patients with skin and soft-tissue infection. Nutrient management plans were used to create 2 exposure variables: seasonal crop field manure application and number of livestock animals at the operation. In a sub-study, we collected 200 isolates from patients stratified by location of diagnosis and proximity to livestock operations. The study measured community-associated MRSA, health care—associated MRSA, and skin and soft-tissue infection status (with no history of MRSA) compared with controls. From a total population of 446,480 patients, 1,539 community-associated MRSA, 1335 health care-associated MRSA, 2895 skin and soft-tissue infection cases, and 2914 controls were included. After adjustment for MRSA risk factors, the highest quartile of swine crop field exposure was significantly associated with community-associated MRSA, health care-associated MRSA, and skin and soft-tissue infection case status (adjusted odds ratios, 1.38 [95% CI, 1.13-1.69], 1.30 [95% CI, 1.05-1.61], and 1.37 [95% CI, 1.18-1.60], respectively); and there was a trend of increasing odds across quartiles for each outcome ($P \leq .01$ for trend in all comparisons). There were similar but weaker associations of swine operations with community-associated MRSA and skin and soft-tissue infection. Molecular testing of 200 isolates identified 31 unique *spa* types, none of which corresponded to CC398 (clonal complex 398), but some have been previously found in swine. Proximity to swine manure application to crop fields and livestock operations each was associated with MRSA and skin and soft-tissue infection. These findings contribute to the growing concern about the potential public health impacts of high-density livestock production.

Donham KJ, Wing S, Osterberg D, al et, Flora JL, Hodne C, et al. Community health and socioeconomic issues surrounding concentrated animal feeding operations. Environ Health Perspect. 2007 Feb;115(2):317-20.
Link: https ://www.ncbi.nlm.nih.gov/pmc/articles/PMC1817697/

> A consensus of the Workgroup on Community and Socioeconomic Issues was that improving and sustaining healthy rural communities depends on integrating socioeconomic development and environmental protection. The workgroup agreed

that the World Health Organization's definition of health, "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity," applies to rural communities. These principles are embodied in the following main points agreed upon by this workgroup. Healthy rural communities ensure a) the physical and mental health of individuals, b) financial security for individuals and the greater community, c) social well-being, d) social and environmental justice, and e) political equity and access. This workgroup evaluated impacts of the proliferation of concentrated animal feeding operations (CAFOs) on sustaining the health of rural communities. Recommended policy changes include a more stringent process for issuing permits for CAFOs, considering bonding for manure storage basins, limiting animal density per watershed, enhancing local control, and mandating environmental impact statements.

Graham JP, Leibler JH, Price LB, Otte JM, Pfeiffer DU, Tiensin T, et al. The animal-human interface and infectious disease in industrial food animal production: rethinking biosecurity and biocontainment. Public Health Rep. 2008;123(3):282-99.
Link: https://www.ncbi.nlm.nih.gov/pubmed/19006971

Understanding interactions between animals and humans is critical in preventing outbreaks of zoonotic disease. This is particularly important for avian influenza. Food animal production has been transformed since the 1918 influenza pandemic. Poultry and swine production have changed from small-scale methods to industrial-scale operations. There is substantial evidence of pathogen movement between and among these industrial facilities, release to the external environment, and exposure to farm workers, which challenges the assumption that modern poultry production is more biosecure and biocontained as compared with backyard or small holder operations in preventing introduction and release of pathogens. An analysis of data from the Thai government investigation in 2004 indicates that the odds of H5N1 outbreaks and infections were significantly higher in large-scale commercial poultry operations as compared with backyard flocks. These data suggest that successful strategies to prevent or mitigate the emergence of pandemic avian influenza must consider risk factors specific to modern industrialized food animal production.

Heaney CD, Myers K, Wing S, Hall D, Baron D, Stewart JR. Source tracking swine fecal waste in surface water proximal to swine concentrated animal feeding operations. Sci Total Environ. Elsevier; 2015; 511:676-83.
Link: http : //www . sciencedirect. com/science/article/pii/S0048969714017641

Swine farming has gone through many changes in the last few decades, resulting in operations with a high animal density known as confined animal feeding operations (CAFOs). These operations produce a large quantity of fecal waste whose environmental impacts are not well understood. The purpose of this study was to investigate microbial water quality in surface waters proximal to swine CAFOs including microbial source tracking of fecal microbes specific to swine. For one year, surface water samples at up- and downstream sites proximal to swine CAFO lagoon waste land application sites were tested for fecal indicator bacteria (fecal coliforms, Escherichia coli and Enterococcus) and candidate swine-specific microbial source-tracking (MST) markers (Bacteroidales Pig-l-Bac, Pig-2-Bac, and Pig-Bac-2, and methanogen P23-2). Testing of 187 samples showed

high fecal indicator bacteria concentrations at both up- and downstream sites. Overall, 40%, 23%, and 61% of samples exceeded state and federal recreational water quality guidelines for fecal coliforms, E. coli, and Enterococcus, respectively. Pig-1 -Bac and Pig-2-Bac showed the highest specificity to swine fecal wastes and were 2.47 (95% confidence interval [CI] = 1.03, 5.94) and 2.30 times (95% CI = 0.90, 5.88) as prevalent proximal down- than proximal upstream of swine CAFOs, respectively. Pig-l-Bac and Pig-2-Bac were also 2.87 (95% CI = 1.21, 6.80) and 3.36 (95% CI = 1.34, 8.41) times as prevalent when 48-hour antecedent rainfall was greater than versus less than the mean, respectively. Results suggest diffuse and overall poor sanitary quality of surface waters where swine CAFO density is high. Pig-1 -Bac and Pig-2-Bac are useful for tracking off-site conveyance of swine fecal wastes into surface waters proximal to and downstream of swine CAFOs and during rain events.

Horton RA, Wing S, Marshall SW, Brownley KA. Malodor as a trigger of stress and negative mood in neighbors of industrial hog operations. Am J Public Health. 2009 Nov;99 Suppl 3:S610-5.
Link: https://www.ncbi.nlm.nih.gov/pubmed/19890165

Objectives. We evaluated malodor and air pollutants near industrial hog operations as environmental stressors and negative mood triggers.
Methods. We collected data from 101 nonsmoking adults in 16 neighborhoods within 1.5 miles of at least 1 industrial hog operation in eastern North Carolina. Participants rated malodor intensity, stress, and mood for 2 weeks while air pollutants were monitored.
Results. Reported malodor was associated with stress and 4 mood states; odds ratios (ORs) for a 1-unit change on the 0-to-8 odor scale ranged from 1.31 (95% confidence interval [CI] = 1.16, 1.50) to 1.81 (95% CI = 1.63, 2.00). ORs for stress and feeling nervous or anxious were 1.18 (95% CI = 1.08, 1.30) and 1.12 (95% CI = 1.03, 1.22), respectively, for a 1 ppb change in hydrogen sulfide and 1.06 (95% CI = 1.00, 1.11) and 1.10 (95% CI = 1.03, 1.17), respectively, for a 1 $\mu g/m^3$ change in semivolatile particulate matter less than 10 µm in aerodynamic diameter (PM_{10}).
Conclusions. Hog odor, hydrogen sulfide, and semivolatile PK◦ are related to stress and negative mood in disproportionately low-income communities near industrial hog operations in eastern North Carolina. Malodor should be considered in studies of health impacts of environmental injustice.

Ma W, Lager KM, Vincent AL, Janke BH, Gramer MR, Richt JA. The role of swine in the generation of novel influenza viruses. Zoonoses Public Health. 2009 Aug;56(6-7):326-37.
Link: https://www.ncbi.nlm.nih.gov/pubmed/19486316

The ecology of influenza A viruses is very complicated involving multiple host species and viral genes. Avian species have variable susceptibility to influenza A viruses with wild aquatic birds being the reservoir for this group of pathogens. Occasionally, influenza A viruses are transmitted to mammals from avian species, which can lead to the development of human pandemic strains by direct or indirect transmission to man. Because swine are also susceptible to infection with avian and human influenza viruses, genetic reassortment between these viruses and/or swine influenza viruses can occur. The potential to generate novel influenza viruses has resulted in swine being labelled 'mixing vessels'. The mixing vessel theory is one mechanism by which unique viruses can be transmitted from an avian reservoir to man. Although swine can generate novel influenza viruses capable of infecting

man, at present, it is difficult to predict which viruses, if any, will cause a human pandemic. Clearly, the ecology of influenza A viruses is dynamic and can impact human health, companion animals, as well as the health of livestock and poultry for production of valuable protein commodities. For these reasons, influenza is, and will continue to be, a serious threat to the wellbeing of mankind.

Mirabelli MC, Wing S, Marshall SW, Wilcosky TC. Asthma symptoms among adolescents who attend public schools that are located near confined swine feeding operations. Pediatrics. 2006 Jul;118(1):e66-75.
Link: http://pediatrics.aappublications.org/content/118/1/e66

Objectives. Little is known about the health effects of living in close proximity to industrial swine operations. We assessed the relationship between estimated exposure to airborne effluent from confined swine feeding operations and asthma symptoms among adolescents who were aged 12 to 14 years.
Methods. During the 1999-2000 school year, 58,169 adolescents in North Carolina answered questions about their respiratory symptoms, allergies, medications, socioeconomic status, and household environments. To estimate the extent to which these students may have been exposed during the school day to air pollution from confined swine feeding operations, we used publicly available data about schools (n = 265) and swine operations (n = 2343) to generate estimates of exposure for each public school. Prevalence ratios and 95% confidence intervals for wheezing within the past year were estimated using random-intercepts binary regression models, adjusting for potential confounders, including age, race, socioeconomic status, smoking, school exposures, and household exposures.
Results. The prevalence of wheezing during the past year was slightly higher at schools that were estimated to be exposed to airborne effluent from confined swine feeding operations. For students who reported allergies, the prevalence of wheezing within the past year was 5% higher at schools that were located within 3 miles of an operation relative to those beyond 3 miles and 24% higher at schools in which livestock odor was noticeable indoors twice per month or more relative to those with no odor.
Conclusions. Estimated exposure to airborne pollution from confined swine feeding operations is associated with adolescents' wheezing symptoms.

Rinsky JL, Nadimpalli M, Wing S, Hall D, Baron D, Price LB, et al. Livestock-Associated Methicillin and Multidrug Resistant *Staphylococcus aureus* Is Present among Industrial, Not Antibiotic-Free Livestock Operation Workers in North Carolina. PLoS One. 2013;8(7).
Link: https://www.ncbi.nlm.nih.gov/pubmed/23844044

Objectives. Administration of antibiotics to food animals may select for drug-resistant pathogens of clinical significance, such as methicillin-resistant *Staphylococcus aureus* (MRSA). In the United States, studies have examined prevalence of MRSA carriage among individuals exposed to livestock, but prevalence of multidrug-resistant *S. aureus* (MDRSA) carriage and the association with livestock raised with versus without antibiotic selective pressure remains unclear. We aimed to examine prevalence, antibiotic susceptibility, and molecular characteristics of *S. aureus* among industrial livestock operation (ILO) and antibiotic-free livestock operation (AFLO) workers and household members in North Carolina.

Methods. Participants in this cross-sectional study were interviewed and provided a nasal swab for *S. aureus* analysis. Resulting *S. aureus* isolates were assessed for antibiotic susceptibility, multi-locus sequence type, and absence of the sen gene (a marker of livestock association).
Results. Among 99 ILO and 105 AFLO participants, *S. aureus* nasal carriage prevalence was 41% and 40%, respectively. Among ILO and AFLO *S. aureus* carriers, MRSA was detected in 7% (3/41) and 7% (3/42), respectively. Thirty seven percent of 41 ILO versus 19% of 42 AFLO *S.* aureus-positive participants carried MDRSA. *S. aureus* clonal complex (CC) 398 was observed only among workers and predominated among ILO (13/34) compared with AFLO (1/35) *S.* aureus-positive workers. Only ILO workers carried scn-negative MRSA CC398 (2/34) and scn-negative MDRSA CC398 (6/34), and all of these isolates were tetracycline resistant.
Conclusions. Despite similar *S. aureus* and MRSA prevalence among ILO and AFLO-exposed individuals, livestock-associated MRSA and MDRSA (tetracycline-resistant, CC398, scn-negative) were only present among ILO-exposed individuals. These findings support growing concern about antibiotics use and confinement in livestock production, raising questions about the potential for occupational exposure to an opportunistic and drug-resistant pathogen, which in other settings including hospitals and the community is of broad public health importance.

Sapkota AR, Curriero FC, Gibson KE, Schwab KJ. Antibiotic-resistant enterococci and fecal indicators in surface water and groundwater impacted by a concentrated swine feeding operation. Environ Health Perspect. 2007 Jul;115(7):1040-5.
Link: https://www.ncbi.nlm.nih.gov/pubmed/17637920

Background. The nontherapeutic use of antibiotics in swine feed can select for antibiotic resistance in swine enteric bacteria. Leaking swine waste storage pits and the land-application of swine manure can result in the dispersion of resistant bacteria to water sources. However, there are few data comparing levels of resistant bacteria in swine manure—impacted water sources versus unaffected sources.
Objectives. The goal of this study was to analyze surface water and groundwater situated up and down gradient from a swine facility for antibiotic-resistant enterococci and other fecal indicators.
Methods. Surface water and groundwater samples (n = 28) were collected up and down gradient from a swine facility from 2002 to 2004. Fecal indicators were isolated by membrane filtration, and enterococci (n = 200) were tested for susceptibility to erythromycin, tetracycline, clindamycin, virginiamycin, and vancomycin.
Results. Median concentrations of enterococci, fecal coliforms, and Escherichia coli were 4- to 33-fold higher in down-gradient versus up-gradient surface water and groundwater. We observed higher minimal inhibitory concentrations for four antibiotics in enterococci isolated from down-gradient versus up-gradient surface water and groundwater. Elevated percentages of erythromycin- ($p = 0.02$) and tetracycline-resistant ($p = 0.06$) enterococci were detected in down-gradient surface waters, and higher percentages of tetracycline- ($p = 0.07$) and clindamycin-resistant ($p < 0.001$) enterococci were detected in down-gradient groundwater.
Conclusions. We detected elevated levels of fecal indicators and antibiotic-resistant enterococci in water sources situated down gradient from a swine facility compared with up-gradient sources. These findings provide additional evidence that water

contaminated with swine manure could contribute to the spread of antibiotic resistance.

Schinasi L, Horton RA, Guidry VT, Wing S, Marshall SW, Morland KB. Air pollution, lung function, and physical symptoms in communities near concentrated swine feeding operations. Epidemiology. 2011 Mar;22(2):208-15.
Link: https://www.ncbi.nlm.nih.gov/pubmed/21228696

Background. Concentrated animal feeding operations emit air pollutants that may affect health. We examined associations of reported hog odor and of monitored air pollutants with physical symptoms and lung function in people living within 1.5 miles of hog operations.
Methods. Between September 2003 and September 2005, we measured hydrogen sulfide (H2S), endotoxin, and particulate matter (PM10, PM2.5, and PM2.5-10) for approximately 2-week periods in each of 16 eastern North Carolina communities. During the same time periods, 101 adults sat outside their homes twice a day for 10 minutes, reported hog odor and physical symptoms, and measured their lung function. Conditional fixed-effects logistic and linear regression models were used to derive estimates of associations.
Results. The log odds (±1 standard error) of acute eye irritation following 10 minutes outdoors increased by 0.53 (±0.06) for every unit increase in odor, by 0.15 (±0.06) per 1 ppb of H2S, and by 0.36 (+0.11) per 10 µg/m3 of PM10. Odor and H2S were also associated with irritation and respiratory symptoms in the previous 12 hours. The log odds of difficulty breathing increased by 0.50 (±0.15) per unit of odor. A 10 µg/m3 increase in mean 12-hour PM2.5 was associated with increased log odds of wheezing (0.84 ± 0.29) and declines in forced expiratory volume in 1 second (-0.04 ± 0.02 L). A 10 EU/mg increase in endotoxin was associated with increased log odds of sore throat (0.10 ± 0.05), chest tightness (0.09 ± 0.04), and nausea (0.10 ± 0.05).
Conclusions. Pollutants measured near hog operations are related to acute physical symptoms in a longitudinal study using analyses that preclude confounding by time-invariant characteristics of individuals.

Schulz J, Friese A, Klees S, Tenhagen BA, Fetsch A, Rosier U, et al. Longitudinal study of the contamination of air and of soil surfaces in the vicinity of pig barns by livestock-associated methicillin-resistant *Staphylococcus aureus.* Appl Environ Microbiol. 2012 Aug;78(16):5666-71.
Link: http://aem.asm.org/content/78/16/5666.fu1l

During 1 year, samples were taken on 4 days, one sample in each season, from pigs, the floor, and the air inside pig barns and from the ambient air and soil at different distances outside six commercial livestock-associated methicillin-resistant *Staphylococcus aureus* (LA-MRSA)-positive pig barns in the north and east of Germany. LA-MRSA was isolated from animals, floor, and air samples in the barn, showing a range of airborne LA-MRSA between 6 and 3,619 CFU/m(3) (median, 151 CFU/m(3)). Downwind of the barns, LA-MRSA was detected in low concentrations (11 to 14 CFU/m(3)) at distances of 50 and 150m; all upwind air samples were negative. In contrast, LA-MRSA was found on soil surfaces at distances of 50, 150, and 300m downwind from all barns, but no statistical differences could be observed between the proportions of positive soil surface samples at the three different distances. Upwind of the barns, positive soil surface samples were found only sporadically. Significantly more positive LA-MRSA

samples were found in summer than in the other seasons both in air and soil samples upwind and downwind of the pig barns. spa typing was used to confirm the identity of LA-MRSA types found inside and outside the barns. The results show that there is regular airborne LA-MRSA transmission and deposition, which are strongly influenced by wind direction and season, of up to at least 300m around positive pig barns. The described boot sampling method seems suitable to characterize the contamination of the vicinity of LA-MRSA-positive pig barns by the airborne route.

Wing S, Horton RA, Rose KM. Air pollution from industrial swine operations and blood pressure of neighboring residents. Environ Health Perspect. 2013 Jan;121(1):92-6.
Link: https://ehp.niehs.nih.gov/1205109/

Background. Industrial swine operations emit odorant chemicals including ammonia, hydrogen sulfide (H2S), and volatile organic compounds. Malodor and pollutant concentrations have been associated with self-reported stress and altered mood in prior studies.
Objectives: We conducted a repeated-measures study of air pollution, stress, and blood pressure in neighbors of swine operations.
Methods. For approximately 2 weeks, 101 nonsmoking adult volunteers living near industrial swine operations in 16 neighborhoods in eastern North Carolina sat outdoors for 10 min twice daily at preselected times. Afterward, they reported levels of hog odor on a 9-point scale and measured their blood pressure twice using an automated oscillometric device. During the same 2- to 3-week period, we measured ambient levels of H2S and PM10 at a central location in each neighborhood. Associations between systolic and diastolic blood pressure (SBP and DBP, respectively) and pollutant measures were estimated using fixed-effects(conditional) linear regression with adjustment for time of day.
Results. PM10 showed little association with blood pressure. DBP [13 (SE)] increased 0.23 (0.08) mmHg per unit of reported hog odor during the 10 min outdoors and 0.12 (0.08) mmHg per 1-ppb increase of H2S concentration in the same hour. SBP increased 0.10 (0.12) mmHg per odor unit and 0.29 (0.12) mmHg per 1-ppb increase of H2S in the same hour. Reported stress was strongly associated with BP; adjustment for stress reduced the odor—DBP association, but the H2S—SBP association changed little.
Conclusions. Like noise and other repetitive environmental stressors, malodors may be associated with acute blood pressure increases that could contribute to development of chronic hypertension.

Appendices

Appendix A

Resolution No. 33-19

RESOLUTION CREATING POLK COUNTY ORDINANCE REGARDING TEMPORARY MORATORIUM ON LIVESTOCK FACILITIES

WHEREAS, Wis. Stat. § 59.02(2) grants the Polk County the authority to adopt resolutions and enact ordinances provides that, except as elsewhere specifically provided in the Wisconsin Statutes, the board of any county is vested with all powers of a local, legislative and administrative character, including the subject matter of health;

WHEREAS, Wis. Stat. § 59.69 authorizes the Polk County Board of Supervisors to adopt ordinances and regulations to promote public health, safety and general welfare;

WHEREAS, the Polk County Comprehensive Plan 2009-2029 states in part that the land use element 8 has the goal that Polk County will have the appropriate/ minimal amount of restrictions to maintain land owners rights, and have high quality lakes, open spaces, parks, orderly growth with focus on commercial development within cities and villages and take into account the impacts to the environment, economy, agriculture, public use health and commercial development;

WHEREAS, the Polk County Comprehensive Plan, element 5 also states in part that some of the Agricultural element goals are to maintain a balance between preservation and use of agriculture, protect natural resources from inappropriate and/or unplanned development, and make Polk County self-sufficient;

WHEREAS, Polk County currently has a Comprehensive Land Use Ordinance (Ordinance No. 07-19), a Shoreland Protection Ordinance (Ordinance No. 08-19), a Floodplain Zoning Ordinance (Ordinance No. 12-17), however, these Ordinances do not set forth specific regulations, methods of permitting, or methods of monitoring of Livestock Facilities within Polk County;

WHEREAS, Polk County residents and property owners have expressed concerns about the importance of preserving the quality of life, environment, natural resources and existing agricultural operations within Polk County in contemplating the operation of Livestock Facilities in Polk County;

WHEREAS, there is a need for adequate time to determine whether action should be taken to amend existing Polk County Ordinances, adopt new ordinances, or take other action given the potential impact of Livestock Facilities in Polk County to adequately protect public health, welfare and safety; and

WHEREAS, it is deemed to be in the best interest of Polk County to create Ordinance 33-19, entitled 'Temporary Moratorium on Livestock Facilities" within the Polk County Ordinances.

NOW THEREFORE, the Polk County Board of Supervisors on behalf of Polk County does here ordain as follows:

Polk County Temporary Moratorium on Livestock Facilities

I. Authority: This Temporary Moratorium on Livestock Facilities Ordinance is adopted pursuant to the powers granted to Polk County under the Wisconsin Constitution and the Wisconsin Statutes, including but not limited to, Wis. Stat. § 59.02(2) and Wis. Stat. § 59.69.

II. Title: The title of this Ordinance is the Temporary Moratorium on Livestock Facilities.

III. Definitions.

1. "Expansion" means the addition of livestock at a pre-existing livestock facility that would result in the number of livestock to exceed 1000 animal units fed, confined, maintained, or stabled.

2. "Livestock" means any of the following:
   a. Swine

3. "Livestock Facility" means a feedlot, farm or other operation where 1000 or more animal units of Livestock are or will be fed, confined, maintained or stabled for a total of 45 days or more in any 12-month period. A "Livestock Facility" includes other facilities utilized as a part of the Livestock Facility operations, such as feedlots, Livestock housing facilities, manure storage structures, and other structures or areas of use.

4. "Moratorium" means the temporary moratorium on Livestock Facilities set forth in this Ordinance.

IV. Purpose: The purpose of this Ordinance and the Moratorium is as follows:

1. To allow Polk County adequate time to study, review, consider and analyze the potential impacts of Livestock Facilities in Polk County.

2. To allow Polk County adequate time to research, analyze and synthesize scientific literature and data regarding the impact of Livestock Facilities on ground water, surface water, air quality and other environmental impacts, as that research and data apply in Polk County.

To allow Polk County adequate time to determine whether a regulatory structure of Livestock Facilities is required in Polk County, which may include:

a. Amendment(s) to existing Polk County Ordinances.

b. Adoption of new ordinances.

c. If a new ordinance is adopted, making modifications or other amendments to existing Polk County Ordinances in light of the new ordinance.

d. Modifications to the Polk County Comprehensive Plan or other Polk County plans or policies.

e. Taking any other steps are necessary in order to protect public health, welfare or safety in Polk County.

4. To allow Polk County adequate time to determine whether it has adequate resources to enforce any new or existing Polk County Ordinances addressing Livestock Facilities.

5. To allow Polk County adequate time to ensure all State of Wisconsin Statutes, Administrative Codes and other applicable laws and regulations are accounted for in any Polk County regulatory structure, and to ensure that Polk County will not take any action that is otherwise preempted by other applicable laws and regulations relating to Livestock Facilities.

V. Moratorium Imposed. The Polk County Board of Supervisors hereby imposes a moratorium on the operation and licensing of new Livestock Facilities that will have 1000 or more animal units and on the operation and licensing of any pre-existing Livestock operations may be undergoing an Expansion if the number of animal units kept at the expanded facility will be 1000 or more.

VI. Duration of Moratorium.

1. The Moratorium shall be in effect for a period of six (6) months from the date this Ordinance is adopted by the Polk County Board of Supervisors.

2. The Polk County Board of Supervisors may rescind this Moratorium at an earlier date upon any of the following events:

a. The analysis, research and study contemplated in this Ordinance is completed and the County Administrator reports the findings to the Polk

County Board of Supervisors as set forth in Section VII in this Ordinance.

b. The Polk County Board of Supervisors adopts any amendment to an existing County Ordinance or adopts a new County Ordinance to address the regulation of Livestock Facilities in Polk County, and such action includes a provision rescinding the Moratorium.

c. Upon circumstances that the Polk County Board of Supervisors determine are in the best interest of the public health, welfare or safety.

3. This Moratorium may be extended for up to six (6) additional months by a majority vote of the Polk County Board of Supervisors if necessary to complete the work contemplated in this Ordinance.

VII. Actions During Moratorium.

1. The Polk County Land and Water Resources Department, Land Information Department and the Health Department is hereby directed to and granted authority to coordinate, organize or take other steps to research, analyze and synthesize scientific literature and data regarding the impact of Livestock Facilities on ground water, surface water, air quality, and other environmental impacts that may impact the health, welfare and safety of Polk County, its residents and visitors.

2. If the County staff and Officials listed above determine that additional financial resources are necessary to fulfill the action items contained herein, they are directed to make such request to the full County Board for consideration.

3. The Polk County Administrator shall report the findings and recommendations on appropriate regulatory approaches relative to the siting and/or operation of Livestock Facilities within Polk County to the full Polk County Board of Supervisors at least 30 days prior to the end of the Moratorium, or as soon as the Polk County Administrator has developed recommendations based upon the work required herein.

VIII. Severability. If a court of competent jurisdiction determines that any section, clause, provision, or portion of this Ordinance is unconstitutional or otherwise invalid, the remainder of this Ordinance shall not be affected thereby.

BY:

Brad Olson, Supervisor, District #1

James Edgell, Supervisor, District #8

Doug Route, Supervisor, District #2

Kim O'Connell, Supervisor, District #9

Dean Johansen, Chair,
Supervisor, District #3,

Larry Jepsen, Supervisor, District #10

Chris Nelson, Supervisor, District #4

Jay Luke, 1st Vice Chair,
Supervisor, District #11

Tracy LaBlanc, Supervisor, District #5

Michael Larsen, Supervisor, District #12

Brian Masters, Supervisor, District #6

Russell Arcand, Supervisor, District #13

Michael Prichard, Supervisor, District #7

John Bonneprlse, 2nd Vice Chair,
Supervisor, District #14

Joe Demulling,Supervisor, District #15

County Administrator's Note:

Matter of Policy.

RA.

Fiscal Impact Note:
The staff expenses as described in this resolution are to be covered by the current operating departmental budgets. If money is needed other that what is currently budgeted, this request will go to the full County Board.

Maggilickre, Finance Director

Approved as to Form and Execution:

Appendix B

Resolution No. 03-20

RESOLUTION EXTENDING MORATORIUM ON SWINE CONCENTRATED ANIMAL FEEDING OPERATIONS

WHEREAS, Polk County enacted Resolution 33-19 placing a temporary moratorium on Swine Concentrated Animal Feeding Operations (hereinafter "Swine CAFO);

WHEREAS, one of the purposes of Resolution 33-19 was to allow the County adequate time to research, analyze and synthesize information regarding the potential impacts of Swine CAFO's in Polk County;

WHEREAS, the County, through the Environmental Services Committee and through public meetings has determined that more time is necessary in order to adequately evaluate the potential impacts, especially as it relates to potential water contamination;

WHEREAS, Resolution 33-19 contemplated an extension of the moratorium, if necessary for up to six (6) additional months;

WHEREAS, Resolution 33-19 further required the Administrator to report to the County Board the findings and recommendations on appropriate regulatory approaches the County should consider at least 30 days prior to the end of the moratorium;

NOW THEREFORE BE IT RESOLVED THAT, the Polk County Board of Supervisors authorize the extension of the moratorium for a period not to exceed an addition six (6) months for the purposes set forth herein and pursuant to the procedure below; and

NOW THEREFORE BE IT FURTHER RESOLVED THAT, the Polk County Board of Supervisors does not authorize any further research on Swine CAFO's as a conditional use within any area subject to the Shoreland Land Use Ordinance and that the potential for a Swine CAFO be limited to the agricultural property within the County that is subject to the Comprehensive Land Use Ordinance in order to maximize the protection of the County's navigable waters; and

NOW THEREFORE BE IT FUTHER RESOLVED THAT, the Polk County Board of Supervisors authorizes the Environmental Services Committee to extend the moratorium on a month-by-month basis beyond the original moratorium, but may not authorize an extension beyond the total of a six (6) months; and

NOW THEREFORE BE IT FUTHER RESOLVED THAT, the month-to-month extensions contemplated herein shall only continue, within the aforementioned limitations, for a period of time to complete the research and analysis outlined in Resolution 33-19; and

BE IT FURTHER RESOLVED THAT, the Environmental Services Committee in conjunction with staff shall report to the full County Board of the findings and the County Administrator is no longer required to provide the County Board with a 30 day advanced briefing as had been originally contemplated in Resolution 33-19.

BY: / Ok

Brad Olson, Supervisor, District #1

Doc Sou.te--

James Edgell, Supervisor, District #8

Kim O'Connell, Supervisor, District #9

Dean Johansen, Chair,
Supervisor, District #3,

Larry Jepsen, Supervisor, District #10

Chris Nelson, Supervisor, District #4

Jay Luke, 1st Vice Chair,
Supervisor, District #11

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Tracy LaBlanc, Supervisor, District #5

Michael Larsen, Supervisor, District #12

Brian Masters, Supervisor, District #6 by Lisa Ross

Russell Arcand, Supervisor, District #13

Michael Prichard, Supervisor, District #7

John Bonneprise, 2nd Vice Chair,
Supervisor, District #14

Joe Demulling, Supervisor, District #15

County Administrator's Note:
Recommended.

Vince Netherland
Polk County Administrator

Fiscal Impact Note:
If awarded, Environmental Services Division would submit an additional funding request for the 2021 budget.

Maggie Wickre, Finance Director

Approved as to Form and Execution:

<---

Malia Malone, Polk County Corporation Counsel

Legal Impact Note:

Legal Impact Note:
This Resolution extends the moratorium for up to an additional 6 months. Because this is still within a total of one year, it is legally appropriate.

Excerpt of Minutes

At its regular business meeting on the_____of 2020, the Polk County Board of Supervisors acted upon **Resolution** No. **03-20: Resolution Extending Moratorium On Swine Concentrated Animal Feeding Operations**

_____

_____

- D Adopted by a majority of the members present by a vote of_____m favor and against.
- D Adopted by unanimous voice vote.
- D Adopted as amended. See Below.
- D Defeated
- D Other: ·

_____

Insert amendment to resolution according to minutes:

SIGNED BY: ATTEST:

_____

Dean Johansen, County Board Chair Lisa Ross, County Clerk

Executive Summary

This Resolution will extend the Swine CAPO moratorium in Resolution 33-19 in month-to-month intervals, as directed by the Environmental Services Committee. The extension is to allow staff and the Committee to address the issues raised by the public about the potential negative impacts of Swine -CAFOs This Resolution -does not have the effect of ultimately prohibiting CAFOs.

Appendix C

Polk County Swine CAFO Stakeholder Survey

1. Are you a resident or property owner in Polk County Yes/ No
2. Please define your understanding of a CAFO:

   _____

   _____

   _____
3. Are you currently involved in livestock production within Polk County with more than 20 animal units? (i.e. 15 dairy cows, 20 beef cows, 2000 chickens, 1111 Turkeys, 50 pigs) Yes/No/Unsure
4. In your opinion, should swine CAFO's be prohibited in Polk County?
   Yes/ No/ Unsure
5. In your opinion, would swine CAFO's be detrimental to Polk County?
   Yes/ No/ Unsure
6. In your opinion, are swine CAFO's already regulated enough?
   Yes/ No/ Unsure
7. What type of CAFO's should Polk County regulate? (i.e. dairy, poultry)
   a. Swine only
   b. All types of livestock
   c. Polk County should not regulate them
8. What do you feel swine CAFO's impact the most? (pick one)
   a. Water Quality
   b. Local infrastructure
   c. Quality of life
   d. Economy
   e. Small farms
   f. Human Health
   g. Keeping youth in our communities
9. If Polk County adopts regulations for swine CAFO's, at how many animal units should the regulations kick in at? (1 swine animal unit= 2.5 hogs)
   a. 250
   b. 500
   c. 750
   d. 1000
   e. 1250 or greater
10. Do you think the proposed conditional use permit process provides reasonable regulation on swine CAFO's? Yes/ No/Unsure
11. If Polk County adopts the proposed swine CAFO regulations, would these regulations prevent you from expanding your farming operation? Yes/ No/ Unsure
12. Do you think the proposed conditional use conditions are unnecessarily burdensome on Ag producers? Yes/ No/ Unsure

13. What is the largest benefit of having swine CAFO's in Polk County?
    a. Local jobs/economy
    b. Continuing family farms
    c. Proper management of agricultural lands
    d. Keeps the rural character of Polk County
    e. No benefit
14. Do you think it makes sense to have similar regulations enforced by the DNR, DATCP, and Polk County? Yes/ No/ Unsure

If you could add one condition to the proposed conditional use conditions, what would it be?

_____
_____
_____

Appendix D

Responses to Survey

Question 1: Are you a resident or property owner in Polk County?

- Total surveys received=63
- 58 Responded
- 55 were residents of Polk County (87%)
- 2 were not Polk County Residents

Question 2: Please define your understanding of a CAFO

- Most popular answer: Concentrated Animal Feeding Operation with greater than 1000 animal units
- Other Responses:
  - Factory/industrial farm
  - Causes serious issues
  - Large scale farming

Question 3: Are you currently involved in livestock production within Polk County with more than 20 animal units? (i.e. 15 dairy cows, 20 beef cows, 2000 chickens, 1111 Turkeys, 50 pigs)

- 62 responded
- 16 were livestock producers (26%)
- 46 were not producers (74%)

Question 4: In your opinion, should swine CAFO's be prohibited in Polk County?

- 61 responded
- 44 said "Yes" (72%)
- 16 said "No" (26%)
- 1 "unsure"

Question 5: In your opinion, would swine CAFO's be detrimental to Polk County?

- 62 Responded
- 47 said they would be detrimental (76%)
- 14 said "No" (23%)
- 1 "Unsure"

Question 6: In your opinion, are swine CAFO's already regulated enough?

- 62 responded
- 14 said there was enough regulation already (23%)
- 46 said "No" (74%)
- 2 "Unsure"

Question 7: What type of CAFO's should Polk County regulate? (i.e. dairy, poultry)]

- 62 responded
- 7 said swine only (11%)
- 46 said "all livestock" (74%)
- 9 said Polk County Should not regulate (15%)

Question 8: What do you feel swine CAFO's impact the most? (pick one)

- 55 responded
- Water Quality= 33 or 60%
- Infrastructure= 12 or 22%
- Quality of Life=16 or 29%
- Local Economy=10 or 18%
- Small farms= 12 or 22%
- Human Health=17 or 31%
- Keeping Youth= 7 or 13%

Question 9: If Polk County adopts regulations for swine CAFO's, at how many animal units should the regulations kick in at? (1 swine animal unit= 2.5 hogs)

- 57 responded
- 250 Animal Units=23 or 40%
- 500 Animal Units=8 or 14%
- 750 Animal Units=7 or 12%

- 1000 Animal Units=13 or 23%
- 1250+ Animal Units=6 or 11%

Question 10: Do you think the proposed conditional use permit process provides reasonable regulation on swine CAFO's?

- 61 responded
- 11 said "Yes" (18%)
- 44 said "No" (72%)
- 6 "Unsure" (10%)

Question 11: If Polk County adopts the proposed swine CAFO regulations, would these regulations prevent you from expanding your farming operation?

- 38 responded
- 4 said "Yes" (11%)
- 31 said "No" (82%)
- 3 "Unsure" (8%)

Question 12: Do you think the proposed conditional use conditions are unnecessarily burdensome on Ag producers?

- 59 responses
- 10 said "Yes" (17%)
- 46 said "No" (78%)
- 3 "Unsure" (5%)

Question 13: What is the largest benefit of having swine CAFO's in Polk County?

- 61 responses
- Local Jobs/Economy=9 or 15%
- Continuing Family Farms= 3 or 5%
- Proper management of Ag Lands= 7 or 11%
- Keeps rural character= 1 or 2%

- No Benefit having swine CAFO= 48 or 79%

Question 14: Do you think it makes sense to have similar regulations enforced by the DNR, DATCP, and Polk County?

- 50 responses
- 24 said "Yes" (48%)
- 13 said "No" (26%)
- 13 said "Unsure" (26%)

Question 15: If you could add one condition to the proposed conditional use conditions, what would it be?

- 350' setback (Larger setbacks)
- Air quality regulations/monitoring
- Disclose any violations in CUP application
- Add CUP in all AG districts and all livestock
- Extend the moratorium
- Disease response strategy for swine diseases
- 30 acre minimum
- No more than 1000 pigs
- Don't exceed 2000 animal units
- Public notification of any lack of compliance
- Compensation for damages and loss of property value
- Cap total animal units
- Test wells in every field to be spread
- Surety Bonds to enforce

Appendix E- Cited Sources

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iv. Kravchenko, J. Novel Population Studies Linking CAFOs to Health Effects in North Carolina. Environmental Health Scholars Fall Forum Presentation. Duke University School of Medicine, 2017.

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vii. Mariëtte Hooiveld, Lidwien A M Smit ... C Joris Yzermans. Doctor-diagnosed Health Problems in a Region with a High Density of Concentrated Animal Feeding Operations: A Cross-Sectional Study. Environ Health. 2016; 15: 24. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4758110/

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x. Schinasi L, Horton RA, Guidry VT, Wing S, Marshall SW, Morland KB. Air pollution, lung function, and physical symptoms in communities near concentrated Swine feeding operations. Epidemiology. 2011 Mar; 22(2):208-15.

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2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1817701/
3. https://www.dhs.wisconsin.gov/environmental/cafo.htm
4. https://water.usgs.gov/owq/AFO/proceedings/afo/OFR/OFR_00-204.pdf
5. https://www.naccho.org/uploads/downloadable-resources/18-06-Concentrated-Animal-Feeding-Operations.pdf
6. https://midwestadvocates.org/assets/resources/MEA_CAFO_Toolkit.pdf

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STATE OF IOWA

THOMAS J. VILSACK
GOVERNOR
SALLY J. PEDERSON
LT. GOVERNOR

DEPARTMENT OF PUBLIC HEALTH
STEPHEN C. GLEASON, D.O., DIRECTOR

January 2001

RISKS FROM LARGE-SCALE LIVESTOCK OPERATIONS IN IOWA

EXECUTIVE SUMMARY

Once characterized by relatively small independently owned farms scattered across the state, hog production is now under the domain of large corporate growers, and dominated by large-scale intensive operations. People living near large hog operations have reported reduced quality of life as well as health problems related to airborne emissions. Physicians and scientists currently believe that the airborne emissions do not cause a real health risk, but the odor causes a 'perceived' health risk. A perceived health risk will not result in physical harm; however it may eventually result in a diminished quality of life. Furthermore, perceived risk may result in increased stress levels that might result in other physical maladies.

This paper is a concise review of science-based literature regarding the suggested impacts that hog confinements may have on the ecosystem and public health.

Odor

There is no conclusive evidence to indicate that exposure to odors from livestock operations cause infectious disease or other physical health threats to residents not working on facility grounds. Although there is documented illnesses from livestock-based industrial exposure, it still remains unclear if nearby residents can be affected. It is practically impossible for pathogens and other microbes to be airborne and migrate very far from the odor source. Furthermore, it is unlikely that there are toxic health effects to people immediately surrounding the facility as a result of exposure to the typical concentration of gases from livestock and manure.

Exposures to animal waste and odors by employees working on site can create health effects. Upper respiratory problems are a main concern. These risks are minimized or eliminated provided the employees follow the appropriate worker protection standards.

Groundwater Exposure

There is no evidence of significant exposure risk or subsequent deleterious health effects associated with confinement areas and groundwater/drinking water. This is due to the slow movement of groundwater and the inability of pathogens of specific health concern to survive under these conditions. Furthermore, there is no evidence of any significant nitrate or other chemical exposure from livestock confinement areas through the groundwater to drinking water supplies.

Nitrates and microorganisms are found in many of Iowa's drinking water wells. This contamination is due to water well systems that are poorly maintained or because the wells are located too close to sources of surface water or shallow groundwater contamination. Such inadequate wells could provide the means for drinking water contamination when located in the immediate proximity of livestock operations.

Surface Water

It is clear that contamination of surface water can have environmental consequences. Livestock manure entering surface waterways can deplete oxygen below levels that are compatible with aquatic life. Human exposure to water that is oxygen-depleted does not cause health effects. Poorly designed and operated livestock confinements or excessive and inappropriate field application of manure may result in contamination of surface water.

Exposure to human pathogens and other microorganisms from animal manure in surface water is not likely to have a significant impact on human health because the few human pathogens in manure would not likely survive the distances to designated recreation areas. Exposure to human sewage in Iowa's surface water poses a more significant risk to human health, and will be a subject of future scientific review.

Also, there is growing concern that overuse of antibiotic prophylaxis has spurred the development of resistant bacteria, increasing the health risks associated with confined animal feeding operations (CAFOs) for both humans and the animals involved. The issue is of concern because healthy farm animals are routinely fed antibiotics to promote growth and prevent infections. This practice can breed strains of drug-resistant bacteria, which may infect people who eat contaminated meat or come into contact with food or water contaminated by the animals' droppings.

Conclusion

Based on current science (e.g., science research publications) and other science-based bodies of knowledge regarding confinement operations, it is concluded that confinement operations do not pose an apparent public health risk.

Aesthetically, there is no denying that odor levels experienced at times are repugnant, primarily due to decomposition of manure and the resulting dissipation of hydrogen sulfide gases ("rotten egg" smell). The psychological effects of livestock odors and gas emissions may be real and can

be manifested in health conditions such as tension, depression, and anger, and deserves future study. Moreover, the quality of life of neighbors to a confinement operation may be significantly diminished.

Sincerely,

Charles Barton, Ph.D.
State Toxicologist

NOTE TO READER

In making a conclusion in regards to CAFOs and potential health threats, guidelines established by the Center for Disease Control and Prevention (CDC)/Agency for Toxic Substances and

Disease Registry (ATSDR) were utilized (ATSDR, 1992). One of the following five categories was assigned to each possible exposure media (i.e., soil, air, and water):

A. Urgent Public Health Hazard;
B. Public Health Hazard;
C. Indeterminate Public Health Hazard;
D. No Apparent Public Health Hazard; or
E. No Public Health Hazard.

These categories were selected to:

- ❖ characterize the degree of public health hazard based on factors such as the existence of potential pathways of human exposure, the susceptibility of the exposed community, the comparison of expected human exposure levels to applicable health-based standards, and an evaluation of existing community-specific health outcome data.

- ❖ determine whether actions should be taken to reduce human exposure to hazardous substances and whether additional information on human exposure and associated health risks is needed and should be acquired by conducting further environmental sampling or other health actions including epidemiologic studies, establishing a registry or a health surveillance program, or environmental health education.

- ❖ identify toxicologic data gaps for substance-specific and generic toxicologic issues.

In selecting the appropriate health hazard category, the total body of information available was considered. Some of the important factors that were weighed in the analysis included these:

- presence of completed or potential exposure pathways;
- on-site and off-site environmental contaminant concentrations;
- potential for multiple source exposures;
- contaminant interactions;
- presence of sensitive subpopulations;
- opportunity for acute or chronic exposures;
- nature of toxic effects associated with site contaminants;
- community-specific health outcome data; and
- community health concerns.

The following is the criteria used for selecting the appropriate category:

URGENT PUBLIC HEALTH HAZARD

This category is used for sites that pose an urgent public health hazard as the result of short-term exposures to hazardous substances. Criteria: Evidence exists that exposures have occurred, are occurring, or are likely to occur in the future; and the estimated exposures are to a substance or substances at concentrations in the environment that, upon short-term exposures (less than 1 year), can cause adverse health effects to any segment of the receptor population. The adverse health effect can be the result of either carcinogenic or noncarcinogenic toxicity from a chemical

exposure. For a noncarcinogenic toxic effect, the exposure exceeds an acute or intermediate minimal risk level (MRL) established in the ATSDR Toxicological Profiles or other comparable value; and /or community-specific health outcome data indicate that the site has had an adverse impact on human health that requires rapid intervention; and /or physical hazards at the site pose an imminent risk of physical injury.

PUBLIC HEALTH HAZARD

This category is used for sites that pose a public health hazard as the result of long-term exposures to hazardous substances. Criteria: Evidence exists that exposures have occurred, are occurring, or are likely to occur in the future; and the estimated exposures are to a substance or substances at concentrations in the environment that, upon long-term exposures (greater than 1 year), can cause adverse health effects to any segment of the receptor population. The adverse health effect can be the result of either carcinogenic or noncarcinogenic toxicity from a chemical exposure. For a noncarcinogenic toxic effect, the exposure exceeds a chronic MRL established in the ATSDR Toxicological Profiles or other comparable value; and/or community-specific health outcome data indicate that the site has had an adverse impact on human health that requires intervention.

INDETERMINATE PUBLIC HEALTH HAZARD

This category is used for sites with incomplete information. Criteria: The limited available data do not indicate that humans are being or have been exposed to levels of contamination that would be expected to cause adverse health effects. However, data or information is not available for all environmental media to which humans may be exposed; and there are insufficient or no community-specific health outcome data to indicate that the site has had an adverse impact on human health.

NO APPARENT PUBLIC HEALTH HAZARD

This category is used for sites where human exposure to contaminated media is occurring or has occurred in the past, but the exposure is below a level of health hazard. Criteria: Exposures do not exceed an ATSDR chronic MRL or other comparable value; and data are available for all environmental media to which humans are being exposed; and there are no community-specific health outcome data to indicate that the site has had an adverse impact on human health.

However, if data become available suggesting that human exposure to hazardous substances at levels of public health concern is occurring, or has occurred in the past, Iowa Department of Public Health will reevaluate the need for any followup.

NO PUBLIC HEALTH HAZARD

This category is used for sites that do not pose a public health hazard. Criteria: There is no evidence of current or past human exposure to contaminated media; and future exposures to contaminated media are not likely to occur; and there are no community-specific health outcome data to indicate that the site has had an adverse impact on human health.

INTRODUCTION

Traditionally, pork production was heavily concentrated in Midwestern Corn Belt states because of the readily available supply of feed. Pork producers managed farrow-to-finish units which means animals were bred, born and raised to market weight in one group in one operation.

Today, production has expanded into other regions and practices have changed. Geographically, the pork industry has grown into states outside the Midwest, particularly the southeastern coastal states. And, production practices are no longer focused primarily on complete farrow-to-finish operations.

In simple terms, pork production has evolved from generalized to specialized. For example, research shows segregating pigs during various growth stages provides a number of benefits. Segregation can promote improved herd health and enable producers to customize nutritional programs. Labor time can be used more efficiently when animals are managed according to age and weight. And, buildings can be better designed for specific animal needs when constructed for particular growth stages (National Pork Producers Council & National Pork Board, 1995a).

Once characterized by relatively small independently owned farms scattered across the state, hog production is now under the domain of large corporate growers, and dominated by large-scale intensive operations (Furuseth, 1997). People living near large hog operations have reported reduced quality of life as well as health problems related to airborne emissions from animal confinement houses, open waste lagoons and spray fields (Schiffman, 1998; Reynolds *et al.*, 1997; Thu *et al.*, 1997; Swine Odor Task Force, 1995). However, physicians have not been able to substantiate the claims from the residents regarding hog confinement-induced health problems. It is believed that the airborne emissions do not cause a real health risk, but that the odor causes a 'perceived' health risk (Star & Gibson, 1985; Boxer, 1990). A perceived health risk will not result in physical harm; however it may eventually result in a diminished quality of life.

This paper is a concise review of science-based literature regarding the suggested impacts that hog confinements may have on the ecosystem and public health.

ECOLOGICAL IMPACT

When managed properly, manure presents little risk to the public or to the environment (National Pork Producers Council & National Pork Board, 1995b). The U.S. Environmental Protection Agency defines a toxic substance as a chemical or mixture that may pose an unreasonable risk of injury to human health or the environment. Hazardous substances include those that present a threat because they are characteristically toxic, corrosive, ignitable, explosive, or chemically reactive. Based on these definitions (U.S. EPA, 1992), hog manure is neither toxic nor hazardous.

Compounds in hog manure, like the compounds in a compost pile, are easily broken down into various nutrient sources for plant uptake. Because hog manure contains only low concentrations of these compounds and nutrients, the products of decomposition are rarely, if ever, present at levels that are toxic or hazardous to local plant and wildlife habitats or human populations (North Carolina Agricultural Research Service, 1995).

Impact on the Ecosystem

If current guidelines, regulations, and standard operating procedures are followed, modern manure management and treatment systems do not overburden local watersheds with nutrients in agricultural runoff, and any changes in local air quality are short term, nonhazardous, and typically involve odors detected at the parts per billion levels (Mitsch & Gosselink, 1993). Because compounds in hog manure are naturally occurring and are not applied in excessive amounts, they are cycled through the ecosystem in the same way as other nutrient sources. As in any operation, occasional accidental releases may occur, but these accidental releases involve only naturally occurring nutrients, which are easily absorbed and incorporated into the environment, producing minimal long term effects.

When manure decomposes, it produces ammonia and hydrogen sulfide, as well as a variety of organic compounds. These compounds, many of which are nutrients necessary for plant growth, are also produced through decomposition processes in natural wetlands, and all of them occur throughout the environment as a result of various natural processes (Mitsch & Gosselink, 1993).

A contaminant is any substance or material that is not naturally present in the environment or that is naturally present at much lower levels. A pollutant is a contaminant that is present at levels that are high enough to make media (e.g., water) unfit for its intended use (U.S. EPA, 1992).

Elements in hog manure are all naturally occurring compounds that biodegrade or easily dissipate. When manure is treated at appropriate rates in lagoons or other treatment systems and is then properly applied to crop and pasture land, the effects on air, water, and soil components of local ecosystems are inconsequential.

The elements in hog manure if not managed correctly can be a contaminant or pollutant (North Carolina Agricultural Research Service, 1995). By treating manure before it is applied to the land and by limiting its application to rates that can be used by plants in natural nutrient cycling processes, such problems are avoided (National Pork Producers Council & National Pork Board, 1995b).

Inorganic copper (Cu), zinc (Zn), and phosphorus (P) are added to animal diets as essential nutrients for growth. If not properly managed the potential for these elements to accumulate in soils from land application is possible. Some of these supplements, like Zn, are more likely to be beneficial to crops than harmful, and many diets tend to be low in Zn. Soil texture, soil pH, climate, and soil water holding capacity are all factors pork producers consider before applying manure to pasture-land or crop-land.

With continual manure application, soil aggregation eventually is improved, soil water holding capacity is increased, and air exchange is enhanced. Additionally, the soil often becomes a better medium of aerobic biological activity. Manure application, if not excessive, thus tends to improve soil quality over time (Council for Agricultural Science and Technology, 1996).

Impact on Wildlife & Domesticated Animals

Large hayfields fertilized with manure provide natural food sources for many grazing wildlife species (Estes, 1995). These herbivores also benefit from wooded buffer zones that are

sometimes used around manure storage systems. Buffer zones typically provide valuable forest and wetland habitats that may be destroyed with other types of development. Carnivorous species, such as owls and hawks, likewise benefit from open areas typical of pork production operations because these species feed on herbivore populations.

When manure is used as fertilizer, it completes a sustainable nutrient system. Manure nutrients are used by agricultural or forage crops, particularly corn. Forage crops are typically made into hay used to feed cattle. Corn is used to feed all livestock species.

Summary: When properly managed in accordance with current guidelines, regulations, and standard operating procedures, modern pork operations do not threaten wildlife or their habitats (Jones & Lawton, 1994). Agricultural production methods (including those used on pork operations) increase food yield while using less space, allowing greater areas of natural habitat to be protected. In fact, farm fields and fallow areas provide some of the last remaining large open areas for wildlife habitat and feeding. That includes areas for threatened and endangered species.

PUBLIC HEALTH IMPACT

Soil

Although the soil at production facilities can affect the workers, it is unlikely that it can affect the public unless the soil contaminates the air or water. For this reason, the potential affects of soil will be discussed along with air and water.

Air

Issues about air pollution resulting from intensive swine production have been addressed by many investigators (see for examples Al-Kanani 1992; Bundy 1991; Sneath 1992). In most of these studies, particular emphasis is placed on control of immediate results, rather than giving much thought to their effects. In other words, concern is focused on reduction of odor and toxic emissions rather than on the effects CAFOs may have on public and environmental health.
The human nose is known to detect over 10,000 different odors despite being able to name only a few of them (Axel, 1995). There is no universally accepted definition of an objectionable odor. Odor, like noise, is a nuisance or disturbance. Generally, the lowest toxic values of the compounds in odor are at least a factor 500 times greater than the odor threshold, and can be smelled at a concentration long before they become a human health risk (Tamminga, 1992).

The human nose is capable of detecting numerous compounds that may be produced from manure handling or storage systems on pork operations. These compounds include ammonia and other nitrogen compounds generated by microbial decomposition. Manure is primarily responsible for the bad odor. Manure is a mixture of undigested feed, intestinal secretions, and normal bacterial cells from the gut plus the metabolic end products of these cells. When manure is undergoing decomposition and has its surface exposed to the air, certain volatile compounds

(especially hydrogen sulfide) are released. These compounds are responsible for the unpleasant odor (Mackie, 1995).

There are over 200 chemicals known to be in hog odor. Although dust, endotoxin, methane, carbon dioxide, and ammonia are present, only hydrogen sulfide is of concern (Schiffman *et al.*, 1995; Adcock & Finelli, 1996). Airborne concentrations of ammonia, dust, and endotoxin detected directly down-wind from swine production facilities are at concentrations below health concerns (Reynolds *et al.*, 1997). Table 1 describes the concentrations of these compounds next to hog lots as well as their health comparison value.

Table 1. Concentrations and comparison values.

Compound	Next to Hog Lot	Comparison Value
Ammonia	0.25 ppm	25 ppm
Dust	Below Detection	N/A
Endotoxin	Below Detection	N/A
Carbon Dioxide	Not Above Background	N/A
Methane	Not Above Background	N/A

ppm is parts per million.
N/A is not applicable to make the comparison.

Hydrogen Sulfide

Hydrogen sulfide (H_2S) is a colorless gas that reeks of rotten eggs. H_2S poisoning is a rarity mainly seen in industrial settings. H_2S poisoning usually occurs by inhalation. Local irritation, along with arrest of cellular respiration, may follow. H_2S forms a complex bond to iron in mitochondrial cytochromes, thereby arresting aerobic metabolism in an effect similar to cyanide toxicity. H_2S can affect all organs, particularly the nervous system. The spectrum of illness depends on the concentration and duration of exposure (Table 2; reviewed in Roth, 1993). It should be noted that the concentration of H_2S found around hog confinements are greatly lower than any concentration which is known to cause any adverse health effect.

The direct irritant action of H_2S on the moist tissues of the eye produces "gas eye." When inhaled, it exerts an irritant action throughout the entire respiratory tract. A consequence may be pulmonary edema. At concentrations of 1000-2000 ppm, it is rapidly absorbed through the lung into the blood, which initially induces rapid breathing. This is followed by respiratory inactivity. At higher concentrations, it exerts an immediate paralyzing effect on the respiratory centers. This sequence of events represents the most important toxic effect of H_2S.

Every study conducted to date has failed to demonstrate that H_2S is carcinogenic (Peak, 1999; Roth, 1993). Furthermore, studies suggest that it does not have any adverse affects on pregnant

women (Saillenfait *et al.*, 1989; Hayden *et al.*, 1990), developing fetuses (Saillenfait *et al.*, 1989; Hemminki *et al.*, 1982) or new-born children (Hayden *et al.*, 1990).

In 1990, Jappinen and colleagues conducted a study to assess possible effects of low concentrations of H_2S on respiratory function of asthmatics. Asthmatics did not experience changes in respiratory function or bronchial responsiveness related to exposure to H_2S. It was concluded that asthmatics intermittently exposed to H_2S (at concentrations much greater than those associated with hog lots) do not cause noticeable effects on respiratory function.

Table 2. Hydrogen Sulfide Dose-Response*

Concentration of H_2S	Response
0.001 ppm	Many people can smell it.
0.02 ppm	Concentration directly offsite of CAFOs.
0.03 ppm	Virtually everyone can smell it.
10 (11) ppm	OSHA (NIOSH) standard.
100-300 ppm	May irritate eyes and throat.
300-500 ppm	May cause headaches and dizziness.
> 700 ppm	May result in death, depending upon the duration of exposure.

* Adapted from Southern Alberta Institute of Technology, 1996.

Carbon Dioxide (CO_2)

Carbon dioxide, a traditionally non-polluting gas present in the ambient air at a concentration of 350 ppm (0.035 percent) under normal conditions, is a natural respiratory product of both humans and animals. Although it is prone to disperse within liquid manure due to its density, vigorous agitation often results in the release of significant amounts of carbon dioxide into the ambient air.

At elevated levels, carbon dioxide can cause respiratory problems, eye irritations and headaches. It is not a highly toxic gas; however, it can cause asphyxiation since it dilutes the oxygen content of inspired air. The threshold limit value (TLV) of carbon dioxide is 5,000 (0.5 percent). Average concentration in swine buildings is 1,000 ppm.

Ammonia (NH4)

Protein from animal feed is the primary source of swine manure nitrogen, which exists in two predominant forms within manure; ammonia and organic nitrogen (Fulhage, 1994). Ammonia in

its pure form is irritating to the eyes at concentrations between 20 and 25 ppm. At levels of 1,500 ppm, exposed persons will cough and froth at the mouth, while at a concentration of 5,000 ppm, the ambient air is deadly (Lorimor, 1994). Fortunately, ammonia has a very sharp, pungent and distinct smell, detectable at levels as low as 5 ppm (Lorimor, 1994). The recommended TLV or maximum acceptable dose is 25 ppm, a level which is debated among safety experts since this concentration can produce burning sensations in the eyes (Lorimor, 1994).

Methane (CH_4)

Methane production by swine occurs in both the digestive tract and the manure decomposition process. Once methane is emitted into the atmosphere it is highly combustible, making it very dangerous, especially in high temperature conditions. At levels of 500,000 ppm (5.0 percent of ambient air), methane can spontaneously explode (Lorimor, 1994). Methane is also dangerous because it is colorless, odorless, and tasteless, making it very difficult to detect. The TLV for methane is 1,000 ppm (1.0 percent of ambient air) and, since methane is lighter than air, it can potentially reach this concentration at the top of unventilated areas such as closed manure pits (Lorimor, 1994). However, manure pits are not known to emit significant levels of methane.

Odor

Minimal data is available concerning the public health effects of odor because most odor studies investigate the impact of specific gases on human health rather than the responses or outcomes elicited from the presence of malodorous air in general. Moreover, odor researchers have not been able to demonstrate whether odor triggers a psychological or physiological response. For example, odors have been found to affect cognitive performance, heart rate and electroencephalogram (EEG) patterns (Schiffman, 1995). However, these responses could be the result of a person merely being distraught or angered because of the offensive smell. Conversely, these symptoms could have emerged from a physiological basis, in which olfactory ciliary receptors in the nose bonded to the odorous compounds, eliciting some sort of signal transduction, which was transmitted to the brain via olfactory neurons.

However, if one uses the World Health Organization's definition of health–"A state of complete physical, mental and social well being and not merely an absence of disease or infirmity"–it does not matter whether the odor psychologically or physiologically induces a response. The point remains that an elicited response can occur in the presence of an offensive odor, altering a person's overall state of well being, which is integral to good health.

In general, odors from manure operations are generated by three sources: (1) buildings and holding facilities, (2) manure storage and treatment, and (3) land application. Odors generated by buildings and holding facilities are reduced most easily by keeping areas clean and well ventilated. Modern facilities that use underfloor manure holding systems generally reduce the levels of ammonia and hydrogen sulfide.

Odorous compounds vary with location, production practices, season, temperature, humidity, time of day, and wind speed and direction (National Pork Producers Council & National Pork

Board, 1995b). All compounds, however, represent elements and nutrients that occur naturally in the environment. For example, throughout the world, naturally occurring wetlands produce more methane than all agricultural land combined. Natural wetlands also produce hydrogen sulfide and other gases typical of anaerobic treatment processes used in pork production.

Lagoon treatment systems typically generate more odors during the initial start-up year because microbial activity has not yet reached its optimum efficiency (North Carolina Agricultural Research Service, 1995). When these biological processes stabilize, treatment lagoons generate negligible odors. Most odor is generated by the lower, most anaerobic layers of a lagoon. If lower layers are allowed to decompose undisturbed, odors are minimized. The upper, more aerobic liquid layers of a lagoon generate significantly less odor. This upper, liquid layer can be siphoned off and applied to soil as fertilizer. When waters from that layer, or from a second-stage treatment lagoon, are properly applied to land as fertilizer, odor is minimized and dissipates rapidly.

Many people living near hog lots feel a sense of malaise; however, doctors typically find that it is extremely difficult to make a definitive diagnosis about "what is wrong with them." Doctors suspect that mass psychogenic illness may well be responsible. Psychological symptoms are usually accompanied by physical complaints (Boxer, 1990). Often, environmental toxins are not apparent. Perception of risk, feelings of no control of the situation, and poor communication are all associated with exposure to bad odor (Star & Gibson, 1985). Additionally, it seems odor levels that just remind the person of the existence of an unpleasant situation will result in symptomology (Donham, 1998).

Summary: The odors from hog confinement operations do not present an apparent public health hazard (Council for Agricultural Science and Technology, 1996; National Pork Producers Council & National Pork Board, 1995b). Elements and nutrients in manure do not present a public health risk because none are released to the environment at concentrations detrimental to air quality. The human nose is sensitive enough to detect some of these compounds at parts per billion levels, which are well below the concentrations that produce adverse human health effects. While odors from pork operations may occasionally be distracting or irritating, they do not directly pose a physical health risk. Periodic air monitoring of air samples will continue to be conducted to ensure that no exposure is occurring to hazardous substances at levels of public health concern.

Water

Arguably, even more troublesome than odor problems is the considerable potential for water pollution associated with CAFO waste disposal that may affect water used for human consumption and irrigation, as well soil quality (National Research Council, 1993). Again, the size of a hog farm is not immediately at issue. In 1996, the Centers for Disease Control in Atlanta reported six miscarriages in LaGrange County, Indiana that resulted from nitrate contamination from a leaking concrete hog manure pit on a relatively small operation (Center for Rural Affairs, 1998). In Iowa at least 100,000 fish were killed in 1997 when a manure spill from

Trace Inc. Pork poisoned eight miles of Crane Creek, part of the Turkey River system. The river is popular recreational waterway between Minnesota and Iowa, meaning that the pollution affected a potentially large human population. The spill occurred when a clogged connection between two lagoons caused one to back up. Information from the Missouri Department of Natural Resources indicates that "more than 60% of operations at farms using wet-handling method for removal and storing manure had evidence of illegal discharge of manure over a five-year period" (Kleiner and Constance, 1998). Similar problems have been reported from North Carolina (Huffman and Westerman, 1995). In other words, the concentration of hogs in a confined space (and the resulting difficulties of efficient disposal of waste) are more of a problem than simply the increased number of animals put into production.

Pathogens present in water can be the result of feces or urine from various wildlife species such as deer, raccoons, opossums, rabbits, rats, mice, and squirrels as well as improperly applied livestock manure (Kneen & Lemley, 1996). Properly handled, stored, and applied manure will not jeopardize the integrity of surface water (Council for Agricultual Science and Technology, 1995). For those pork operations that require state and/or federal permits, the discharge of manure into lakes, streams or other surface water bodies is strictly prohibited. Public water systems are required to filter surface water sources to remove the risk of water contamination.

Manure management systems that are properly managed do not contaminate groundwater or surface water resources. Properly constructed lagoons remove nutrients naturally present in manure before their application to soil or ground (Huffman & Westerman, 1995). However, some shallow aquifers located beneath several lagoons in Iowa have became contaminated; fortunately, no one is consuming water from these aquifers. It should not pose as a public health hazard as long as no one installs wells into these contaminated aquifers.

Nitrates

It has been suggested that there is a slight chance that manure run-off might possibly contaminate drinking water with nitrates. Other sources typically contribute to elevated nitrate levels (Sneed, 1991). They include naturally occurring background levels in wetland areas, human sewage systems, and run-off from commercial fertilizers. In Iowa, the greatest contributor to increased levels of nitrates in drinking water is fertilizer.

Well depth and proximity to operational areas can significantly affect nitrate levels in well water. When wells are placed and installed properly, natural attenuating factors in groundwater systems effectively reduce the nutrient and bacteria concentrations to safe, typically nondetectable concentrations (Ritter & Chirnside, 1990).

Nitrites and nitrates are naturally occurring compounds that result from various biological processes. Those processes include microbial decomposition that is an essential component of nutrient cycling in natural ecosystems (Mitsch & Gosselink, 1993). Air itself is made up of about 70 percent nitrogen. Nitrogen cycling is essential for plants, wildlife, and atmospheric activity.

Although nitrate may be dangerous to humans and wildlife in extremely high doses, runoff from pork production is rarely the primary contributing factor in groundwater or surface water

contamination (Sneed, 1991). Commercial fertilizer presents as much of a risk when over-applied or applied at the wrong time as does manure. When that happens, the plant is unable to use all the nutrient compounds and, as a result, groundwater or surface water can be contaminated.

The primary human health effect of excess nitrate levels in drinking water is methemoglobinemia, or "blue baby syndrome." That condition is extremely rare and documented cases in the United States are particularly unusual.

Summary: Very little manure run-off gets into surface water. That which occasionally may occur is at concentrations that are not deleterious to public health. Therefore, there is no apparent public health hazard associated with water. Some shallow aquifers in Iowa have become contaminated; fortunately, no one is consuming water from these aquifers. They should not pose as a public health hazard as long as no one installs wells into these contaminated aquifers.

Other Media

There is no evidence that the public is at risk to zoonotic diseases from confined animal feeding operations. However, farm workers, veterinarians, and slaughterhouse employees may be susceptible to exposure to zoonotic diseases throughout their daily activities. Although those who interact with the animals can potentially be exposed to zoonotic diseases, modern hygienic practices, producer and veterinarian knowledge of these diseases, and the development of antibiotics and vaccines minimize the already low risk for disease transfer from animals to producers. It is in the best interest of producers to maintain healthy animals and a safe working environment.

Antibiotic-Resistant Bacteria

There is growing concern that overuse of antibiotic prophylaxis has spurred the development of resistant bacteria, increasing the health risks associated CAFOs for both humans and the animals involved. The issue is of concern because healthy farm animals are routinely fed antibiotics to promote growth and prevent infections. This practice can breed strains of drug-resistant bacteria, which may infect people who eat contaminated meat or come into contact with food or water contaminated by the animals' droppings.

CONCLUSION

In summary, exposures to gases and dusts inside swine buildings may result in high levels of respiratory disease in workers. Regarding people living in the neighborhood of swine production facilities, they may experience symptoms similar to workers. However, levels of toxicants measured in the outdoor air are significantly less than what is associated with occupational illnesses. These concentrations are not apparently high enough to cause disease by themselves. It appears there are some very complex interactions between the psyche of individuals and the

physical symptoms seen. People feeling stressed and out of control are vulnerable to even the suggestion of toxicants in their environment. **Thus, CAFOs are not an apparent public health hazard.** This conclusion is in congruence with the conclusions derived by experts in the field (Donham, 1998). However, if data become available suggesting that human exposure to hazardous substances at levels of public health concern is occurring, or has occurred in the past, Iowa Department of Public Health will reevaluate the need for any follow-up.

The actions that the psychological well being may have on physical well being are still unknown. Apparently, odor from confinement operations may result in an increase in stress. What impact this long-term stress has on individuals has yet to be examined through a toxicological perspective. However, it may be fair to state that the evidence suggests that the odors may diminish the quality of life in some individuals.

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Public Health/Worker Safety

Here's what misinformed critics say:

"Hog farm employees and people living near hog farms show symptoms of respiratory, physical and emotional illness. Emissions from hog barns cause headaches, runny noses, sore throats, excessive coughing, diarrhea and burning eyes."

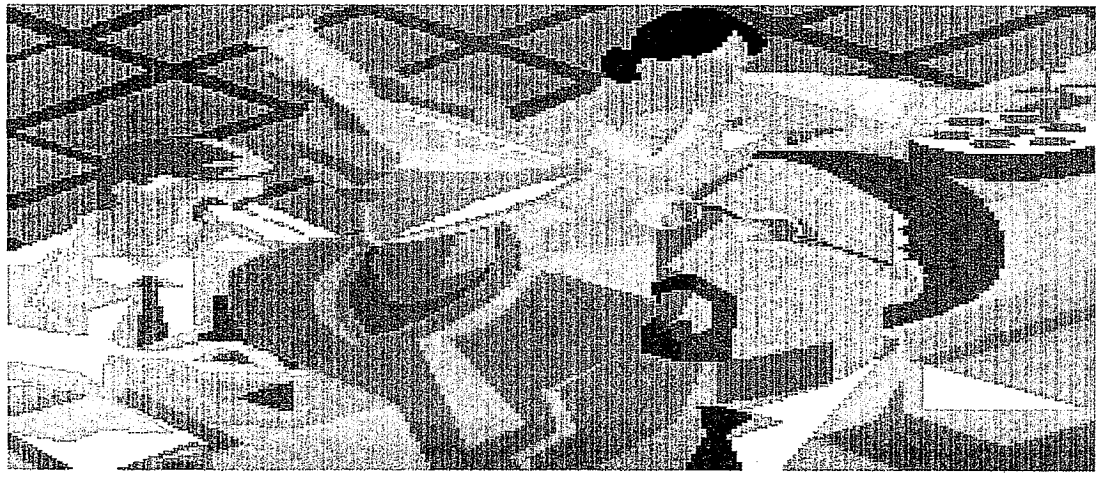
Public Health

- Research indicates livestock production is not a significant public health concern, but public sensitivity on the issue is increasing.

- As with other issues in the pork industry, rural activists and environmental groups use the issue of public health to gain attention and pursue other agendas.

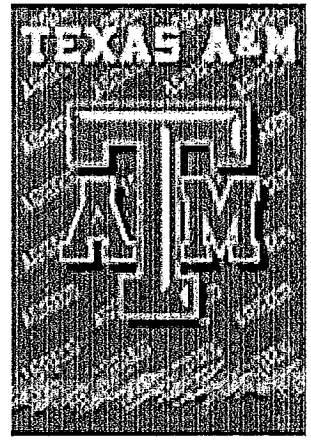
Scientific Study

A number of studies conducted by well-known, credible, academic institutions and government agencies have found no cause for public health concern due to hog production facilities



Texas A&M

- A study examined over 900 articles and abstracts from journals, regulatory documents and academic conference proceedings.



- Virtually no direct links could be drawn between livestock air emissions and public health.

Missouri Department of Health

- An exposure investigation was conducted near one of the largest hog farms in the U.S., located in north Missouri, to determine if neighbors were being exposed to harmful levels of ammonia.

- The investigation concluded no connection could be found between ammonia levels coming from the hog farm and adverse health effects.

Purdue University

- Air was measured from two 1,100 hog finishing barns in north Missouri.

- Two Barns for ammonia, hydrogen sulfide, particulates and non-methane VOC's + Odor

Overall, barn emissions are very low

Dust (PM10) was found to be about 1/6 of EPA's estimate

New Regulations

- New federal regulations which apply to larger hog farms, clearly address land application of manure and set new standards to help producers safely use nutrients in the manure.

- CAFOs are required under the new regulations to have manure management plans showing that manure nutrients are collected, stored and land applied at rates that protect water and soil quality.

- On many farms these nutrients are incorporated into the soil rather than spread or sprayed which reduces odor and the potential for the process to drift across property lines.

Human Illness and Water Contamination

- There have been no reported outbreaks of human illness from hog wastes and water contamination
- Outbreaks are not dependent on the size of the animal production facility.
- Several outbreaks have been associated with petting zoos or country fairs.