TOWN OF LAKETOWN

POLK COUNTY, WISCONSIN

ORDINANCE NO. 22-01
CONCENTRATED ANIMAL FEEDING OPERATIONS (CAFO) ORDINANCE

APPENDIX A

Journal Articles
University Programs
Regulatory & Court Documents
Media Articles

Journal Articles

1. Alarcón, L.V., Allepuz, A. & Mateu, E. Biosecurity in pig farms: a review. *Porc Health Manag* **7,** 5 (2021).
   Link: https://doi.org/10.1186/s40813-020-00181-z
   The perception of the importance of animal health and its relationship with biosecurity has increased in recent years with the emergence and re-emergence of several diseases difficult to control. This is particularly evident in the case of pig farming as shown by the recent episodes of African swine fever or porcine epidemic diarrhea. Moreover, a better biosecurity may help to improve productivity and may contribute to reducing the use of antibiotics. Biosecurity can be defined as the application of measures aimed to reduce the probability of the introduction (external biosecurity) and further spread of pathogens within the farm (internal biosecurity). Thus, the key idea is to avoid transmission, either between farms or within the farm. This implies knowledge of the epidemiology of the diseases to be avoided that is not always available, but since ways of transmission of pathogens are limited to a few, it is possible to implement effective actions even with some gaps in our knowledge on a given disease. The development of quantitative assessment methods will permit a more precise selection of measures and a fine evaluation of their impact. Collaboration with other branches of science such as sociology or psychology may help to the sustainable implementation of biosecurity plans.

2. Almond, G. Water: Optimizing Performance While Reducing Waste. *46th Annual North Carolina Pork Conference North Carolina State University*, 2002.
   Link: Water: Optimizing Performance (ncsu.edu)
   Due to the relative abundance of water and its "low price", there previously was little demand for research on the role of water and water delivery systems in US pork production, and specifically with applications to North Carolina. Water is important in pork production for two general reasons: its role in pig performance and its contribution to waste.

3. American Academy of Pediatrics. Committee on Environmental Health and Committee on Infectious Diseases, 2009. Drinking water from private wells and risks to children. *Pediatrics* 123(6):1599–1605.
   Link: Drinking Water From Private Wells and Risks to Children (aappublications.org)
   Drinking water for approximately one sixth of US households is obtained from private wells. These wells can become contaminated by pollutant chemicals or pathogenic organisms and cause illness. Although the US Environmental Protection Agency and all states offer guidance for construction, maintenance, and testing of private wells, there is little regulation. This policy statement provides recommendations for inspection, testing, and remediation for wells providing drinking water for children.

4. American Association of Swine Veterinarians. Holding Time Calculations for Feed Ingredients to Mitigate Virus Transmission. February 4, 2020
   Link: Holding-Time-Calculations-for-Feed-Ingredients-to-Mitigate-Virus-Transmission
   Imported feedstuffs are not all manufactured and handled in the same way. Consideration should be given to the conditions of manufacture and how these products are handled and transported. Feedstuffs that are manufactured, sealed, handled and shipped under biosecure conditions that produce a product free of pathogens and prevents post-processing contamination are not a risk to animal health. If a feedstuff is not produced under biosecure conditions, is produced under unknown conditions or is not sealed to prevent post-processing contamination, a holding time gives an opportunity for viral contaminants to naturally degrade and to not be infectious.

5. American Association of Swine Veterinarians. On-Farm Euthanasia of Swine. 2016 #04970-11/16
   Link: 2016EuthRec-EN.pdf (aasv.org)
   Euthanasia is the humane process whereby the pig is rendered insensible, with minimal pain and distress, until death. For the euthanasia process or method to be considered humane, it must be quick, effective and reliable. Key elements for determining if a method is humane include: • minimal pain and distress to the pig during administration, • rapid loss of consciousness, • death is achieved quickly and consistently. This brochure provides practical recommendations for the on-farm euthanasia of swine. It also highlights euthanasia methods that have been shown to meet the definition for humane euthanasia based on the available scientific literature. However, this list may not be all-inclusive. Other options may be used as long as they meet the definition and key elements for euthanasia discussed above.

6. American Association of Swine Veterinarians. Swine Disease Manual - Porcine Reproductive and Respiratory Syndrome
   Link: Porcine Reproductive and Respiratory Syndrome (PRRS)
   In some operations, it may be economically feasible to depopulate, clean and disinfect the facilities and, after a few weeks, repopulate with stock free of PRRS and other major diseases. Herd closure for at least 200 days has also been used as another means to stabilize a breeding herd without depopulating. Most breeding stock companies today provide PRRS-free seed stock which was once a major limitation. Before embarking on this strategy, one should honestly assess risk factors for re-infection of the herd as well as the level of biosecurity that can be maintained by the producer. Herds located in swine-dense areas are at great risk for re-infection.

7. American Public Health Association. Precautionary Moratorium on New and Expanding Concentrated Animal Feeding Operations. November 5, 2019. Policy Number: 20194
   Link: Precautionary Moratorium on New and Expanding CAFOs (apha.org)
   These operations function with the high throughput and rapid turnover of an industrialized system. The enormous accumulation of manure and other untreated waste is often stored and disposed of in a manner that pollutes the air, surface, and groundwater, posing risks to the environment and human health, particularly for CAFO workers and nearby residents. This policy statement calls for a moratorium on the establishment of new CAFOs and expansion of existing CAFOs until regulation and enforcement conditions are in place to adequately protect the public's health.

8. Arora, K. General Guidelines on Composting of HPAI Infected Carcasses. *Iowa State Extension Store*. July 2017.
   Link: General Guidelines on Composting of HPAI Infected Carcasses (iastate.edu)

Containment of highly pathogenic avian influenza (HPAI) is a critical step which must be properly performed to ensure human and animal safety. This publication discusses how to prepare to contain a potential outbreak and what should be done to safely contain it.

9. 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.

10. 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.

11. Broom, DM. (2003) Causes of Poor Welfare in Large Animals During Transport. *Veterinary research communications, 27 Suppl 1*, 515–518.
Link: Causes of poor welfare in animal transport (nih.gov)
The welfare of animals during transport should be assessed using a range of behavioral, physiological and carcass quality measures. In addition, health is an important part of welfare so the extent of any disease, injury or mortality resulting from, or exacerbated by, transport should be measured. Many of the indicators are measures of stress in that they involve long-term adverse effects on the individual. Key factors affecting the welfare of animals during handling and transport which are discussed are: attitudes to animals and the need for training of staff; methods of payment of staff; laws and retailers' codes; genetics, especially selection for high productivity; rearing conditions and experience; the mixing of animals from different social groups; handling procedures: driving methods; stocking density; increased susceptibility to disease and increased spread of disease.

12. Brumm, M. Patterns of Drinking Use in Pork Production Facilities. (2006) *Nebraska Swine Reports.* 221.
Link: Patterns of Drinking Water Use in Pork Production Facilities
The amount of drinking water needed daily by the pig depends on numerous influences, including temperature, diet, stage of production and health. Daily drinking water needs for pigs range from less than 0.5 gal/pig/day for newly weaned pigs to greater than 1.5 gal/pig/day for grow-finish pigs. Water requirements for breeding swine range from 3 to 4 gal/day for gestating females and 6 gal/day for lactating swine.

13. 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
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.

14. 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.

15. 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.

16. 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.

17. 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
    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.

18. Center for Food Security and Public Health, Iowa State University. Prepare for animal disease threats.
    Link: CFSPH - Center for Food Security and Public Health (iastate.edu)
    African Swine Fever was confirmed for the first time in recent years in samples from pigs in the Dominican Republic on July 28. Keeping this transboundary disease out is key.

19. Centro del los Derechos Del Migrante. Recruitment Revealed: Fundamental Flaws in the H-2 Temporary Worker Program and Recommendations for Change. 2018
    Link: Recruitment Revealed
    This report reveals the reality of international labor recruitment for low-wage, temporary jobs in the United States, examining recruitment in Mexico, home to the largest number of temporary migrants who labor under H-2 visas in the U.S. The findings are based on data gathered by Centro de los Derechos Migrante through a groundbreaking survey and lengthy interviews of hundreds of H-2 workers.

20. Chambers, PG, Grandin, T, et.al. *Guidelines for humane handling, transport, and slaughter of livestock*. Food and Agriculture Organization of the United Nations Regional Office for Asia and the Pacific. RAP Publication 2001/4
Link: https://www.fao.org/3/x6909e/x6909e.pdf
Guidelines with several specifics on handling, design of pens and chutes, and good animal welfare standards.

21. Chen, C-T, Crespi, et. al. Long-run impacts of trade shocks and export competitiveness: Evidence from the U.S. BSE event. *Agricultural Economics*. 2020; 51: 941– 957.
Link: https://doi.org/10.1111/agec.12602
Examines how comparative advantages of major beef exporters changed following the 2003 bovine spongiform encephalopathy (BSE) outbreak, which significantly disrupted the U.S. beef trade until approximately 2007. Using longitudinal data on beef export values and constructed revealed comparative advantage measures, we show that while some measures of the long-run impacts of BSE on U.S. beef export competitiveness have returned to pre-2003 levels, the U.S.'s comparative advantage has not. Long-term trade competitiveness may not simply return to normal even after a short-term disruption.

22. 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.

23. Coffey, Brian et al., The Economic Impact of BSE on the U.S. Beef Industry: Product Value Losses, Regulatory Costs, and Consumer Reactions, Kansas State University, April 2000
Link: Economic Impact of BSE
As BSE spread outside Europe to Japan and, in mid-2003, to Canada, USDA enhanced its surveillance efforts and increased funding for BSE related research. Regulatory efforts to counter the disease were further strengthened when, on December 23, 2003, it was reported that a dairy cow in Washington state had tested positive. Within days of the announcement, 53 countries banned imports of U.S. cattle and beef products. In 2003, U.S. beef exports were valued at $3.95 billion and accounted for 9.6 percent of U.S. commercial beef production. The import bans caused U.S. beef exports to plummet and exports for the year declined 82 percent below 2003's level.

24. Costa, T, Akdeniz, N. A review of the animal disease outbreaks and biosecure animal mortality composting systems. *Waste Management*, Volume 90, 2019, Pages 121-131,
Link: https://doi.org/10.1016/j.wasman.2019.04.047
Despite the development of new vaccines and the application of rigorous biosecurity measures, animal diseases pose a continuing threat to animal health, food safety, national economy, and the environment. Intense livestock production, increased travel, and changing climate have increased the risk of catastrophic animal losses due to infectious diseases. In the event of an outbreak, it is essential to properly manage the infected animals to prevent the spread of diseases. The most common disposal methods used during a disease outbreak include burial, landfilling, incineration

and composting. Biosecurity, transportation logistics, public perception, and environmental concerns limit the use of some of these methods. During a disease outbreak, the large number of mortalities often exceeds the capacity of local rendering plants and landfills. Transporting mortalities to disposal and incineration facilities outside the production operation introduces biosecurity risks. Burying mortalities is limited by the size and availability of suitable sites and it has the risk of pathogen survival and contamination of groundwater and soil. Portable incinerators are expensive and have the potential to aerosolize infectious particles. Composting, on the other hand, has been recognized as a biosecure disposal method. Although composting has been shown to eliminate HPAI, FMD, PED, and PRRS viruses, no studies have been reported regarding African swine fever. More studies are needed to show the biosecurity of composting in eliminating infectious diseases and especially microbial DNA, which is often referred to be the reason for reoccurring diseases.

25. Costa, D. Employers increase their profits and put downward pressure on wages and labor standards by exploiting migrant workers. *Economic Policy Institute,* Aug 27, 2019.
Link: Employers and Migrant Workers
Our current immigration system isn't working for workers. Instead, it benefits low-road employers who exploit the immigration status of unauthorized immigrants and authorized guestworkers through a legal framework that puts downward pressure on wages and leaves migrant workers powerless to enforce their labor rights and hold employers accountable. This hurts both migrants and the U.S. workers—citizens and lawful permanent residents—who work alongside them. Congress needs to reform the U.S. immigration system by granting lawful permanent resident status to the current unauthorized immigrant population; revising temporary work visa program rules; enacting new protections from retaliation for migrant workers; appropriating more funding for labor standards enforcement; and permanently banning employers from hiring through temporary work visa programs if they have violated immigration or labor laws.

26. Cullens, F. Water Use on Dairy Farms. Michigan State University Extension. October 18, 2011.
Link: Water use on dairy farms - MSU Extension
A reliable, high quality water supply is essential to dairy farms. Water is used for animal consumption, milk cooling, cleaning and sanitizing equipment, cow cooling, irrigating crops, producing value added products, moving manure and cleaning the barns via flush systems.

27. Dee SA, Deen J. Evaluation of an industry-based sanitation protocol for transport vehicles contaminated with porcine reproductive and respiratory syndrome virus. *J Swine Health Prod.* 2006;14(3):126-132.
Link: Evaluation of an industry-based sanitation protocol
Contaminated livestock trailers certainly represent a significant risk for movement of the virus between and within herds. Historically, this disease risk has been effectively mitigated in some cases with the use of trailer washing, disinfection protocols, and thermo-assisted drying and decontamination (TADD) systems. This paper summarizes four studies that evaluated individual aspects of trailer sanitation programs including TADD and multiple disinfectants alone, as well several protocols that include washing, disinfection and TADD. To test a protocol, using conditions found on commercial swine production units, for sanitation of 1:150 scale models of commercial transport vehicles contaminated with porcine reproductive and respiratory syndrome virus (PRRSV). High-pressure washing of transport trailers, followed by 90 to 120 minutes exposure to either modified potassium monopersulfate or quaternary ammonium chloride disinfectants applied with a hydrofoamer is likely to eliminate residual infectious PRRSV.

28. Dee, SA, Bauermann, FV, Niederwerder, et. al (2018). Survival of viral pathogens in animal feed ingredients under transboundary shipping models. *PloS one*, *13*(3), e0194509.
Link: https://doi.org/10.1371/journal.pone.0194509

The goal of this study was to evaluate survival of important viral pathogens of livestock in animal feed ingredients imported daily into the United States under simulated transboundary conditions. Eleven viruses were selected based on global significance and impact to the livestock industry, including Foot and Mouth Disease Virus (FMDV), Classical Swine Fever Virus (CSFV) and African Swine Fever Virus (ASFV). Surrogate viruses with similar genetic and physical properties were used for 6 viruses. Results support published data on transboundary risk of PEDV in feed, demonstrate survival of certain viruses in specific feed ingredients ("high-risk combinations") under conditions simulating transport between continents and provide further evidence that contaminated feed ingredients may represent a risk for transport of pathogens at domestic and global levels.

29. Deschuyffeleer, T. P., Tyberghien, L. F., Dickx, V. L., Geens, T., Saelen, J. M., Vanrompay, D. C., & Braeckman, L. A. (2012). Risk assessment and management of Chlamydia psittaci in poultry processing plants. *The Annals of occupational hygiene*, *56*(3), 340–349.
Link: https://doi.org/10.1093/annhyg/mer102

Chlamydia psittaci causes respiratory disease in poultry and can be transmitted to humans. Historical outbreaks of psittacosis in poultry workers indicated the need for higher awareness and an efficient risk assessment and management. This group reviewed relevant previous research, practical guidelines, and European directives. Subsequently, basic suggestions were made on how to assess and manage the risk of psittacosis in poultry processing plants based on a classical four-step approach. Collective and personal protective measures as well as the role of occupational medicine are described. Despite the finding that exposure is found in every branch, abattoir workstations seem to be associated with the highest prevalence of psittacosis. Complete eradication is difficult to achieve. Ventilation, cleaning, hand hygiene, and personal protective equipment are the most important protective measures to limit and control exposure to C. psittaci. Adequate information, communication, and health surveillance belong to the responsibilities of the occupational physician. Future challenges lay in the rigorous reporting of infections in both poultry and poultry workers and in the development of an avian and human vaccine.

30. 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.

31. Dyal JW, Grant MP, Broadwater K, et al. COVID-19 Among Workers in Meat and Poultry Processing Facilities — 19 States, April 2020. *MMWR Morb Mortal Wkly Rep* 2020:557-561
Link: COVID-19 Among Workers in Meat and Poultry Processing Facilities (cdc.gov)

Congregate work and residential locations are at increased risk for infectious disease transmission including respiratory illness outbreaks. SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19), is primarily spread person to person through respiratory droplets. Nationwide, the meat and poultry processing industry, an essential component of the U.S. food infrastructure, employs approximately 500,000 persons, many of whom work in proximity to other workers (*1*).

Because of reports of initial cases of COVID-19, in some meat processing facilities, states were asked to provide aggregated data concerning the number of meat and poultry processing facilities affected by COVID-19 and the number of workers with COVID-19 in these facilities, including COVID-19–related deaths. Qualitative data gathered by CDC during on-site and remote assessments were analyzed and summarized. During April 9–27, aggregate data on COVID-19 cases among 115 meat or poultry processing facilities in 19 states were reported to CDC.

32. Eastridge, M. Water Usage on Dairy Farms. *Buckeye Dairy News Ohio State University Extension* Volume 8 Issue 1.
Link: Water Usage on Dairy Farms (osu.edu)
As we always say "water is the most important nutrient", but all too often it is the most ignored nutrient when we are thinking of nutrition and animal performance. Therefore, we must constantly monitor water quality and quantity on dairy farms for animal health and performance and for protecting the environment.

33. 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.

34. Foltz JD, Jackson-Smith D, Chen L. Do purchasing patterns differ between large and small dairy farms? Econometric evidence from three Wisconsin communities. *Agric Resour Econ.* Rev. 2002;31(1):28–38
Link: Do Purchasing Patterns Differ Between Large and Small Dairy Farms? (umn.edu)
Using farm data from three dairy-dependent communities in Wisconsin, this study addresses the question: Do small farms spend more locally than large farms? The work develops a theoretical model of farm cost functions with transaction costs varying between local and distant input sources. This model is then tested econometrically, describing farm costs and where they were spent as a function of transaction/search costs and farm characteristics. The results suggest that scale does matter to farm spending patterns.

35. Fox, M. A., et. al. (2016). Meeting the public health challenge of protecting private wells: Proceedings and recommendations from an expert panel workshop. *Science of the Total Environment*, *554-555*, 113-118.
Link: https://doi.org/10.1016/j.scitotenv.2016.02.128
Private wells serving fewer than 25 people are federally unregulated, and their users may be exposed to naturally occurring agents of concern. This panel assessed current conditions of ground water as a source for private wells, identified emerging threats, critical gaps in knowledge, and public health needs, and recommended strategies to guide future activities to ensure the safety of private drinking water wells.

36. 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.

37. 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.

38. 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.

39. 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 population's 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.

40. 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.

41. 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.

42. Guberti, V., Khomenko, S., Masiulis, M. & Kerba S. 2019. African swine fever in wild boar ecology and biosecurity. *FAO Animal Production and Health Manual No. 22.* Rome, FAO, OIE and EC.
Link: en-manual-asfinwildboar-2019-web.pdf (oie.int)
African swine fever (ASF) is a devastating hemorrhagic viral disease of pigs, affecting domestic and wild pigs of all ages and sexes. The disease is the cause of major economic losses, threatens food security and safe trade, and challenges sustained swine production in affected countries. Since ASF emergence in Georgia in 2007, the disease has spread to many countries in Europe and in 2018 was detected in East Asia, where over 60 percent of global domestic pig inventories are found.

43. 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.

44. Guthrie, T. Water Needs of Pigs. Michigan State Extension. May 2011
Link: Water needs of pigs - MSU Extension
How much water do pigs need? Pigs lose water through four routes: kidneys (urination), intestines (defecation), lungs (respiration) and some through evaporation (skin- sweat glands are largely dormant).

45. Harmon, J. Drip Cooling for Sows in Farrowing House. *Iowa State Extension Store.* October 2008
Link: Drip Cooling of Sows in Farrowing House (iastate.edu)
Research indicates that summer heat stress on sows can be reduced by using a system that continually drips water on the sow's shoulder in hot weather.

46. Heaney CD, et. al. Source tracking swine fecal waste in surface water proximal to swine concentrated animal feeding operations. *Sci Total Environ.* 2015;511:676-683.
Link: http://www.sciencedirect.com/science/article/pii/S0048969714017641
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.

47. 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.

48. 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.

49. 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.

50. 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.

51. Hseu Z-Y, Chen Z-S. Experiences of Mass Pig Carcass Disposal Related to Groundwater Quality Monitoring in Taiwan. *Sustainability*. 2017; 9(1):46.
Link: https://doi.org/10.3390/su9010046

Although burial is widely used to dispose of the large number of pig carcasses generated from FMD outbreaks, this disposal method has not undergone comprehensive scientific investigation. After the burial of culled pigs, dissolved components from carcass decomposition are slowly released into the external environment in the form of leachate, depending on the local environmental conditions. Nevertheless, the properties of groundwater, including total bacterial count, fecal coliform, *Salmonella* spp., nitrite-N, nitrate-N, ammonium-N, sulfate, NPOC, total oil, and TDS, are recognized as indicators of groundwater contamination resulting from the pig carcass burial during the FMD outbreak in Taiwan. Because very few studies have been performed, there is not enough information on the characteristics of groundwater at the burial sites, duration of pig carcass decomposition, and effects of leachate on groundwater quality worldwide. Although information on the biological and chemical characteristics of leachate is gradually being accumulated from the limited number of studies, guidelines for groundwater quality control should be established for livestock carcass disposal in all modern countries.

52. Isakson, Hans R. An analysis of the impact of swine CAFOs on the value of nearby houses. A*gricultural Economics*. November 2008; pages 365-372.
Link: https://doi.org/10.1111/j.1574-0862.2008.00339.x

The impact of 39 swine confined or concentrated animal feeding operations (CAFOs) in Black Hawk County, Iowa on 5,822 house sales is explored by introducing a new variable that more accurately captures the effects of prevailing winds, exploring potential adverse effects within concentric circles around each CAFO, managing selection bias, and incorporating spatial correlation into the error term of the empirical model. Large adverse impacts suffered by houses that are within 3 miles and directly downwind from a CAFO are found. Beyond 3 miles, CAFOs have a generally decreasing adverse impact on house prices as distance to the CAFO increases.

53. Jackson, L, Keeney, D, Gilbert, E. Swine manure management plans in North-Central Iowa: Nutrient loading and policy implications. *Journal of Soil and Water Conservation* April 2000, 55 (2) 205-212.
Link: Swine manure management plans in North-Central Iowa...

Public record were used to document the manure management practices of CAFOs housing 59,700 finishing hogs in a 1,554 ha area of Hamilton County, Iowa. Together, they generated an estimated 811,500 kg of nitrogen (N) each year, more than 70% of which volatilized into the atmosphere. CAFOs minimized the area required for applying manure by underestimating manure N content, projecting above average crop yields, and applying manure to soybeans. Some fields were claimed by more than one operator, and some field sizes were overestimated. Manure application based on crop demand for phosphorus would require 9,350 ha of cropland, compared to the 990 ha actually used. Several policy changes could alleviate the nutrient management problems...

54. 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

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.

55. Johns Hopkins Bloomberg School of Public Health. Putting Meat on the Table: Industrial Farm Animal Production in America. January 2008
Link: Putting-the-meat-on-the-table.pdf (jhsph.edu)

One of the most serious unintended consequences of industrial food animal production is their growing public health threat. They can be harmful to workers, neighbors, and even those living far from the facilities through air and water pollution, and via the spread of disease. Workers in and neighbors experience high levels of respiratory problems. In addition, workers can serve as a bridging population, transmitting animal-borne diseases to a wider population. A lack of appropriate treatment of enormous amounts of waste may result in contamination of nearby waters with harmful levels of nutrients and toxins, as well as bacteria, fungi, and viruses.

56. Kilpatrick, J. Concentrated Animal Feeding Operations and Proximate Property Values. *The Appraiser Journal*, July 2001 Pages: 301-306.
Link: Concentrated Animal Feeding Operations and Proximate Property Values (state.ar.us)

Property located near a concentrated animal feeding operation (CAFO) will be negatively impacted by this externality. The degree of impairment depends on proximity and property type and use. Properties with higher unimpaired values are probably impacted more than otherwise lower valued properties.

57. Kilpatrick, J. Animal Operations and Residential Property Values. *The Appraisal Journal*, Winter 2015: 41-50
Link: animaloperationsJKwinter2015.pdf (greenfieldadvisors.com)

Animal feeding and processing operations have grown more concentrated, with each facility handling much larger numbers of animals than traditional farms. The larger concentration of animals impacts the quality of surrounding air and water. In addition, the facilities impact the economic conditions of the communities where they are located. All of these factors can potentially affect the value of nearby houses. This article summarizes the current literature on how animal operations may affect the value of residential properties located near such facilities... Overall, the empirical evidence indicates that residences near Animal Operations are significantly affected, and data seems to suggest a valuation impact of up to 26% for nearby properties, depending on distance, wind direction, and other factors. Further, there has been some suggestion that properties immediately abutting an AO can be diminished as much as 88%. ... Not only are residences affected, but nearby small farms can be impacted by such factors as water degradation and insects.

58. Kikuti, M, Paploski IA, et al. Newly emerging PRRSV Lineage 1C variant nomenclature. *Swine Health Information Center* 2021
Link: SHMP 2020l21.34 [Lineage 1C variant nomenclature].pdf
Recent outbreaks caused by a highly similar PRRSV variant have been reported. As we move forward with investigations of these farm level outbreaks, we continue to confirm that these form a tight genetic cluster not similar (using a 98% nucleotide identity as a cutoff) to any other sequences from our dataset. Because this is such a specific variant and because the common nomenclature used in the field has been restriction fragment length polymorphism (RFLP) typing, a review of the limitations of different PRRSV classification systems is warranted.

59. Kim, J, Goldsmith P. Using Spatial Econometrics to Assess the Impact of Swine Production on Residential Property Values American Agricultural Economics Association, Denver, July, 2004
Link: Microsoft Word - Paper 2 v.4pete.doc (rosemonteis.us)
A spatial hedonic model is developed to assess monetary harm of confined animal feeding operations (CAFOs) on property values, taking explicitly spatial dependence in property values into account. Spatial autocorrelation was found in the form of spatial lag dependence, not spatial error dependence. When spatial lag dependence is explicitly taken into account, on average the impact is reduced by 18%. The magnitude of the spatial autoregressive parameter was about 0.2 for the 1-mile distance band, meaning one-fifth of the house value could be explained by the values of the neighboring houses.

60. 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.

61. Knobeloch, L., Gorski, P., Christenson, M., & Anderson, H. (2013). Private drinking water quality in rural Wisconsin. *Journal of environmental health*, *75*(7), 16–20.
Link: Private drinking water quality in rural Wisconsin - PubMed (nih.gov)
Between July 1, 2007, and December 31, 2010, Wisconsin health departments tested nearly 4,000 rural drinking water supplies for coliform bacteria, nitrate, fluoride, and 13 metals as part of a state-funded program that provides assistance to low-income families. The authors' review of laboratory findings found that 47% of these wells had an exceedance of one or more health-based water quality standards. Test results for iron and coliform bacteria exceeded safe limits in 21% and 18% of these wells, respectively. In addition, 10% of the water samples from these wells were high in nitrate and 11% had an elevated result for aluminum, arsenic, lead, manganese, or strontium. The high percentage of unsafe test results emphasizes the importance of water quality monitoring to the health of nearly one million families including 300,000 Wisconsin children whose drinking water comes from a privately owned well.

62. Kravchenko J , Rhew S, Akushevich I, Agarwal P, Lyerly, HK: Mortality and Health Outcomes in North Carolina Communities Located in Close Proximity to Hog Concentrated Animal Feeding Operations. *NC Med J* Sep-Oct 2018;79(5):278-288.
Link: https://www.ncbi.nlm.nih.gov/pubmed/30228132
Background Life expectancy in southeastern North Carolina communities located in an area with multiple concentrated animal feeding operations (CAFOs) after adjusting for socioeconomic factors remains low. We hypothesized that poor health outcomes in this

region may be due to converging demographic, socioeconomic, behavioral, and access-to-care factors and are influenced by the presence of hog CAFOs.
Methods We studied mortality, hospital admissions, and emergency department (ED) usage for health conditions potentially associated with hog CAFOs-anemia, kidney disease, infectious diseases, and low birth weight (LBW)-in North Carolina communities located in zip codes with hog CAFOs (Study group 1), in zip codes with > 215hogs/km^2 (Study group 2), and without hog CAFOs (Control group). We compared cause-specific age-adjusted rates, the odds ratios (ORs) of events in multivariable analyses (adjusted for 6 co-factors), and the changes of ORs relative to the distance to hog CAFOs.
Results Residents from Study groups 1 and 2 had higher rates of all-cause mortality, infant mortality, mortality of patients with multimorbidity, mortality from anemia, kidney disease, tuberculosis, and septicemia, and higher rates of ED visits and hospital admissions for LBW infants than the residents in the Control group. In zip codes with > 215hogs/km^2, mortality ORs were 1.50 for anemia ($P < 0.0001$), 1.31 for kidney disease ($P < 0.0001$), 2.30 for septicemia ($P < 0.0001$), and 2.22 for tuberculosis ($P = 0.0061$).
Limitations This study included a lack of individual measurements on environmental contaminants, biomarkers of exposures and co-factors, and differences in residential and occupational locations.
Conclusions North Carolina communities located near hog CAFOs had higher all-cause and infant mortality, mortality due to anemia, kidney disease, tuberculosis, septicemia, and higher hospital admissions/ED visits of LBW infants. Although not establishing causality with exposures from hog CAFOs, our findings support the need for future studies to determine factors that influence these outcomes, as well as the need to improve screening and diagnostic strategies for these diseases in North Carolina communities adjacent to hog CAFOs.

63. Lawley, Chad. Hog Barns and Neighboring House Prices: Anticipation and Post-Establishment Impacts. *American Journal of Agricultural Economics*. 2021 May; Vol. 103. Issue 3: 1099-1121
Link: https://doi.org/10.1111/ajae.12203
The impact of large-scale hog barns on residential property values is at the forefront of local concerns about livestock development. In this article, I examine the impact of hog barns on house prices in an intensive production region of Manitoba, Canada. Timing of barn establishment and precise locations of houses and barns are used to gain a better understanding of the dynamic impacts of hog barns on house prices. I find that ***houses within 2 km of a hog barn sell for 5.7% less*** than similar houses located a little farther away from a barn. Quasi-myopic specifications indicate that ***house prices fall by 6.2% up to three years prior*** to barn establishment, consistent with market anticipation of the future location of hog barns. Accounting for anticipation increases the post-establishment discount to 8%, suggesting that ignoring anticipation of new barn establishment biases estimated post-establishment impacts downwards.

64. Lowe, J., Gauger, P., et.al. (2014). Role of Transportation in Spread of Porcine Epidemic Diarrhea Virus Infection, United States. *Emerging Infectious Diseases*, *20*(5), 872-874.
Link: https://doi.org/10.3201/eid2005.131628
Harvest facilities serve as a source of contact between many swine farms with different health statuses. This study suggests that collection points, such as harvest facilities and livestock auction markets, can be an efficient source of contamination of transport vehicles that return to pig farms and likely played a role in rapidly disseminating PEDV across vast geographic regions shortly after PEDV was first identified in the United States. These data also suggest that the contamination of transport vehicles leaving the harvest facilities increased as the prevalence of PEDV–positive transport vehicles and virus load coming into the facility increased.

65. 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.

66. Malecki, K., Schultz, A. A., Severtson, D. J., Anderson, H. A., & VanDerslice, J. A. (2017). Private-well stewardship among a general population based sample of private well-owners. *The Science of the total environment*, *601-602*, 1533–1543.
Link: https://doi.org/10.1016/j.scitotenv.2017.05.284

Private well stewardship, including on-going testing and treatment, can ensure private well users are able to maintain source-water quality and prevent exposures to potentially harmful constituents in primary drinking water supplies. Unlike municipal water supplies, private well users are largely responsible for their own testing and treatment and well stewardship is often minimal. The importance of factors influencing regular testing, and treatment behaviors, including knowledge, risk perception, convenience and social norms, can vary by geography and population characteristics. The primary goals of this study were to survey a general statewide population of private well users in Wisconsin in order to quantify testing and treatment patterns and gather data on motivations and barriers to well stewardship. The majority of respondents reported using and drinking well water daily but only about one half of respondents reported testing their wells in the last ten years and of these, only 10% reported testing in the last 12months. Bacteria and nitrates were contaminants most often tested; and, a private laboratory most often conducted testing. The most commonly reported water treatment was a water softener. Living in a particular geographic region and income were the most significant predictors of water testing and treatment. Iron and hardness, which influence water aesthetics but not always safety, were the most commonly reported water quality problems. Health concerns or perceived lack thereof were, respectively, motivators and barriers to testing and treatment. Limited knowledge of testing and treatment options were also identified as barriers. Results confirm previous findings that well stewardship practices are minimal and often context specific. Understanding the target population's perceptions of risk and knowledge are important elements to consider in identifying vulnerable populations and developing education and policy efforts to improve well stewardship.

67. 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.

68. Mathewson P, Evans S, Byrnes T, Joos A, Naidenko O. *Environmental Monitoring Assessment (*2020) 192: 724. Link: Health & economic impact of nitrate pollution in drinking water: a Wisconsin case study
Link: https://doi.org/10.1007/s10661-020-08652-0
Nitrate contamination of drinking water, common in agricultural areas, increases the risk of certain cancers and impacts fetal development during pregnancy. Building on previously published methodology, this study evaluates nitrate-attributable disease cases and adverse birth outcomes as well as their economic costs for Wisconsin, USA. Nitrate is the most common contaminant in groundwater in Wisconsin. Two-thirds of the state's residents use groundwater as the primary source of drinking water. Here, we analyze nitrate exposure from drinking water in Wisconsin based on nitrate test results for community water systems for the period of 2010–2017 and a novel methodology for estimating nitrate exposure for the 28% of state's residents who use private wells. We estimate that annually, 111–298 combined cases of colorectal, ovarian, thyroid, bladder, and kidney cancer in Wisconsin may be due to nitrate contamination of drinking water. Each year, up to 137–149 cases of very low birth weight, 72–79 cases of very preterm birth, and two cases of neural tube defects could be due to nitrate exposure from drinking water. The direct medical cost estimates for all nitrate-attributable adverse health outcomes range between $23 and $80 million annually. Simulating targeted reductions in the counties with the highest current drinking water nitrate concentrations resulted in similar reductions in adverse health outcomes as statewide reduction efforts, up to nitrate reductions of 20%. Time trend analysis suggests that groundwater nitrate concentrations are overall increasing. Thus, nitrate contamination of water supplies in Wisconsin is a public health problem that needs to be addressed.

69. MacDonald G.J., et.al. (2017). Strategies to Improve Private-Well Water Quality: A North Carolina Perspective. *Environmental health perspectives*, *125*(7), 076001.
Link: https://doi.org/10.1289/EHP890
Evidence suggests that the 44.5 million U.S. residents drawing their drinking water from private wells face higher risks of waterborne contaminant exposure than those served by regulated community water supplies. These recommendations could improve the health of North Carolinians facing elevated risks of exposure to waterborne contaminants because of their reliance on inadequately monitored and maintained private wells. Because many of the challenges in N.C. are common nationwide, these recommendations could serve as models for other states.

70. May, J. Estimating Water Usage on Michigan Swine Farms. Michigan State University Extension.
Link: Water_Use_for_Swine_Farms
Swine farms use well water for watering animals, cleaning facilities, animal cooling and in some instances for moving manure from the barn to the storage structure. Most pigs are raised in an all-in/all-out environments where one group of pigs, at the same stage of production, is moved into a location and stays there until that group is ready to move to the

next location or on to slaughter. Between groups the facility is thoroughly cleaned by pre-soaking and/or pressure washing.

71. Milligan, W. R., Fuller, Z. L., Agarwal, I., Eisen, M. B., Przeworski, M., & Sella, G. (2021). Impact of essential workers in the context of social distancing for epidemic control. *PloS one*, *16*(8), e0255680.
Link: https://doi.org/10.1371/journal.pone.0255680
New emerging infectious diseases are identified every year, a subset of which become global pandemics like COVID-19. In the case of COVID-19, many governments have responded to the ongoing pandemic by imposing social policies that restrict contacts outside of the home, resulting in a large fraction of the workforce either working from home or not working. To ensure essential services, however, a substantial number of workers are not subject to these limitations, and maintain many of their pre-intervention contacts. To explore how contacts among such "essential" workers, and between essential workers and the rest of the population, impact disease risk and the effectiveness of pandemic control, we evaluated several mathematical models of essential worker contacts within a standard epidemiology framework. The models were designed to correspond to key characteristics of cashiers, factory employees, and healthcare workers. We find in all three models that essential workers are at substantially elevated risk of infection compared to the rest of the population, as has been documented, and that increasing the numbers of essential workers necessitates the imposition of more stringent controls on contacts among the rest of the population to manage the pandemic. Importantly, however, different archetypes of essential workers differ in both their individual probability of infection and impact on the broader pandemic dynamics, highlighting the need to understand and target intervention for the specific risks faced by different groups of essential workers. These findings, especially in light of the massive human costs of the current COVID-19 pandemic, indicate that contingency plans for future epidemics should account for the impacts of essential workers on disease spread.

72. 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.

73. Morrow, WE, Ferket, PR. Alternative Methods for the Disposal of Swine Carcasses Factsheet. *North Carolina State University, Raleigh, NC* Nov 2001. ANS01-815S
Link: https://projects.ncsu.edu/project/swine_extension/publications/factsheets/815s.pdf
There is probably no one best way to dispose of swine mortality carcasses. The optimum system for any particular farm location would need to be selected based on a number of criteria, including the current state of the protein/oil market, the biosecurity required, the distance to processing sites, the local public's perception, and the government regulations that apply to that location. The tonnage of dead pigs produced annually is substantial. A typical 5000 sow farrow-to-finish farming system (with mortality losses of 7%, 10%, 5%, 1%, and 1% in the sow, neonatal, nursery, growing, and finishing herd, respectively) will produce over 200,000 pounds of dead pigs annually. In many farming systems in the USA, actual losses may be much higher. The

integration of swine agriculture has concentrated these mortality losses into smaller and smaller geographic areas.

74. Niederwerder MC, Stoian A, Rowland R, et al. Infectious Dose of African Swine Fever Virus When Consumed Naturally in Liquid or Feed. *Emerging Infectious Diseases*. 2019;25(5):891-897
Link: Infectious Dose of AFS virus when Consumed Naturally in Liquid or Feed
Although plant-based feed has been identified as a potential route for African Swine Fever Virus (ASFV) virus introduction onto swine farms, little is known about the risks for ASFV transmission in feed. We aimed to determine the minimum and median infectious doses of the Georgia 2007 strain of ASFV through oral exposure during natural drinking and feeding behaviors. The minimum infectious dose of ASFV in liquid was 10^0 50% tissue culture infectious dose ($TCID_{50}$), compared with 10^4 $TCID_{50}$ in feed. The median infectious dose was $10^{1.0}$ $TCID_{50}$ for liquid and $10^{6.8}$ $TCID_{50}$ for feed. Our findings demonstrate that ASFV Georgia 2007 can easily be transmitted orally, although higher doses are required for infection in plant-based feed.

75. Oun A, Kumar A, Harrigan T, Angelakis A, Xagoraraki I. nk: Effects of Biosolids and Manure Application on Microbial Water Quality in Rural Areas in the US. *Water* 2014;6:3701–3723.
Link: https://doi.org/10.3390/w6123701
Most of the waterborne disease outbreaks observed in North America are associated with rural drinking water systems. The majority of the reported waterborne outbreaks are related to microbial agents (parasites, bacteria and viruses). Rural areas are characterized by high livestock density and lack of advanced treatment systems for animal and human waste, and wastewater. Animal waste from livestock production facilities is often applied to land without prior treatment. Biosolids (treated municipal wastewater sludge) from large wastewater facilities in urban areas are often transported and applied to land in rural areas. This situation introduces a potential for risk of human exposure to waterborne contaminants such as human and zoonotic pathogens originating from manure, biosolids, and leaking septic systems. This paper focuses on waterborne outbreaks and sources of microbial pollution in rural areas in the US, characterization of the microbial load of biosolids and manure, association of biosolid and manure application with microbial contamination of surface and groundwater, risk assessment and best management practice for biosolids and manure application to protect water quality. Gaps in knowledge are identified, and recommendations to improve the water quality in the rural areas are discussed.

76. 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.
Link: http://dx.doi.org/10.1100/tsw.2001.16
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.

77. Paploski, IA, Corzo C, Rovira Al, et al. Temporal Dynamics of Co-circulating Lineages of Porcine Reproductive and Respiratory Syndrome Virus. *Frontiers in Microbiology*. 2019 Vol 10: 2486
Link: https://www.frontiersin.org/article/10.3389/fmicb.2019.02486
Porcine Reproductive and Respiratory Syndrome Virus (PRRSV) is the most important endemic pathogen in the U.S. swine industry. Despite control efforts involving improved biosecurity and different vaccination protocols, the virus continues to circulate and evolve. One of the foremost challenges in its control is high levels of genetic and antigenic diversity. Here, we quantify the co-circulation, emergence and sequential turnover of multiple PRRSV lineages in a single swine-producing region in the United States over a span of 9 years (2009–2017) using the Morrison Swine Health Monitoring Project housed at the University of Minnesota.

78. Polaris Project. Recruitment, Human Trafficking, and Temporary Visa Workers. Sept 2021
Link: Recruitment, Human Trafficking, and Temporary Visa Workers
This report examines the roles recruitment practices, regulations, and enforcement play in the experiences of trafficking victims who are in the United States on temporary worker visas. Data from the U.S. National Human Trafficking Hotline identified 4,8163 likely victims from January 1, 2015 – December 31, 20204 who were in the United States and working under any of the visa categories listed at the time of their abuse.

79. Polaris Project. Human Trafficking on Temporary Work Visas: A Data Analysis 2015-2017.
Link: Human Trafficking on Temporary Work Visas
This report details how human traffickers are using workers under H-2A, H-2B and other temporary work visas and making legitimate businesses, consumers and the U.S. government complicit in the $150 billion business of global human trafficking.
.

80. Poulsen, Melissa N.a,,b; Pollak, Jonathana; Sills, Deborah L.c; Casey, Joan A.d; Nachman, Keeve E.a,,e,,f; Cosgrove, Sara E.g,,h; Stewart, Daltonc; Schwartz, Brian S. High-density poultry operations and community-acquired pneumonia in Pennsylvania. *Environmental Epidemiology*: June 2018 - Volume 2 - Issue 2 - p e013
Link:https://journals.lww.com/environepidem/Fulltext/2018/06000/High_density_poultry_operations_and.5.aspx
Background Air pollution from industrial food animal production may increase vulnerability to pneumonia among individuals living in nearby communities. We evaluated the association between individual-level residential proximity to high-density poultry operations and diagnosis with community-acquired pneumonia (CAP).
Methods We conducted a nested case–control study among patients of a large health system in Pennsylvania, USA. We used diagnostic codes for pneumonia and chest imaging from electronic health records from 2004 to 2015 to identify 11,910 child and adult cases of CAP and 59,550 frequency-matched outpatient controls. We estimated exposure to poultry operations using data from nutrient management plans, calculating an inverse-distance squared activity metric based on operation and residential addresses that incorporated number, size, and location of operations. Mixed effects logistic regression models evaluated associations between quartiles of the activity metric and CAP diagnosis. Models controlled for sex, age, race/ethnicity, Medical Assistance (proxy for low socioeconomic status), and smoking status.
Results Individuals living in the highest (versus lowest) quartile of the poultry operation metric had 66% increased odds of CAP diagnosis (adjusted odds ratio [confidence interval]) Q2, 0.98 [0.74, 1.31]; Q3, 1.17 [0.93, 1.46]; Q4, 1.66 [1.27, 2.18]).
C*onclusions* Findings suggest that living in closer proximity to more and larger poultry operations may increase risk of CAP, contributing to growing concern regarding public health impacts of industrial food animal production.

81. Powlson, David. et.al. (2008) When Does Nitrate Become a Risk for Humans? *J. Environ. Qual*. 37:291–295
Link: When Does Nitrate Become a Risk for Humans? (unl.edu)
Is nitrate harmful to humans? Are the current limits for nitrate concentration in drinking water justifi ed by science? Th ese questions were addressed at a symposium on "Th e Nitrogen Cycle and Human Health" held at the annual meeting of the Soil Science Society of America (SSSA). Although they sound like old questions, it became clear there is still substantial disagreement among scientists over the interpretation of evidence on the issue—disagreement that has lasted for more than 50 years.

82. 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.* 2007:17381742.
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.

83. Rasmussen SG, Casey JA, Bandeen-Roche K, Schwartz BS. Proximity to Industrial Food Animal Production and Asthma Exacerbations in Pennsylvania, 2005–2012. *International Journal of Environmental Research and Public Health*. 2017; 14(4):362.
Link: https://doi.org/10.3390/ijerph14040362
The research on industrial food animal production (IFAP) and asthma exacerbations in the United States has relied on small sample sizes and/or self-reported outcomes. We assessed associations of proximity to large-scale and densely stocked swine and dairy/veal IFAP with three types of asthma exacerbations: hospitalizations, emergency encounters, and oral corticosteroid (OCS) medication orders from Geisinger Clinic in Pennsylvania. We used a diagnosis code (*International Classification of Diseases, 9th Revision, Clinical Modification* code 493.x) and medication orders from electronic health records to identify these exacerbations among asthma patients (n = 35,269) from 2005–2012. We compared residential proximity to swine or dairy/veal IFAP (dichotomized as <3 miles (4.8 km) or ≥3 miles) among asthma patients with and without exacerbations and estimated odds ratios using multilevel logistic regression. In adjusted models, proximity to IFAP was associated (odds ratio (95% confidence interval)) with OCS orders (1.11 (1.04–1.19)) and hospitalizations (1.29 (1.15–1.46)), but not emergency encounters (1.12 (0.91–1.37)). This study contributes to growing evidence that IFAP may impact health, in this case clinically-documented asthma exacerbations. No prior study has evaluated the association of IFAP and clinically-documented asthma exacerbations in the United States.

84. 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.

85. Rioja-Lang, FC. A Review of Swine Transportation on Priority Welfare Issues. *Frontiers in Veterinary Science* Febraury 22, 2019.
Link: Review of Swine Transportation Research(frontiersin.org)
Review is to present the best available scientific knowledge on key animal welfare issues during swine transport, such as transport duration and distance, time off feed and water, rest intervals, environmental conditions, loading density, and transport of young animals, based on their impact on stress, injury, fatigue, dehydration, body temperature, mortality, and carcass and meat quality.

86. 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://doi.org/10.1086/605630
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.

87. Rosov K, Mallin M, Cahoon L: Waste nutrients from U.S. animal feeding operations: Regulations are inconsistent across states and inadequately assess nutrient export risk. *Journal of Environmental Management*, Volume 269, 2020
Link: https://doi.org/10.1016/j.jenvman.2020.110738
Livestock production in the United States has been transformed over the past several decades, largely as a result of widespread development of industrial-scale mass production facilities,

termed Animal Feeding Operations (AFOs). These facilities generate massive amounts of animal waste that can concentrate in small areas. Animal wastes from AFOs have led to high levels of nutrients and other pollutants in nearby surface waters, as well as groundwater. The environmental problems associated with these disposal practices have led to federal and state modifications to the rules and regulations governing waste practices. We summarize the federal guidelines for AFO nutrient management, focusing on swine, and compare the regulations of four AFO-rich states in different regions of the USA. Furthermore, we discuss inconsistencies among regulations and regulatory gaps, and identify issues with waste nutrient management practices that lead to environmental degradation in watersheds hosting AFOs. Finally, we address these shortcomings and the need to implement policy updates that would alleviate some of these environmental and human concerns.

88. 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.

89. 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.

90. Sanhueza, JM, Stevenson, MA, Vilalta, C, Kikuti, M, Corzo, C. Spatial relative risk and factors associated with porcine reproductive and respiratory syndrome outbreaks in United States breeding herds. *Preventive Veterinary Medicine*, Volume 183, 2020,
Link: https://doi.org/10.1016/j.prevetmed.2020.105128
Details of incident cases of porcine reproductive and respiratory syndrome (PRRS) in United States breeding herds were obtained from the Morrison's Swine Health Monitoring Project. Herds were classified as cases if they reported an outbreak in a given season of the year and non-cases if they reported it in a season other than the case season or if they did not report a PRRS outbreak in any season. The geographic distribution of cases and non-cases was compared in each season of the year. The density of farms that had a PRRS outbreak during summer was higher in Southern Minnesota and Northwest-central Iowa compared to the density of the underlying population of non-case farms. This does not mean that PRRS outbreaks are more frequent during summer in absolute terms, but that there was a geographical clustering of herds breaking during summer in this area. Similar findings were observed in autumn. In addition, the density of farms reporting spring outbreaks was higher in the Southeast of the United States compared to that of the

underlying population of non-case farms. A similar geographical clustering of PRRS outbreaks was observed during winter in the Southeast of the United States. Pig dense areas were associated with a higher incidence rate throughout the year. However, this association tended to be stronger during the summer. Additionally, herds with ≥2500 sows had an increased incidence rate during all seasons except spring compared to those with <2500 sows. PRRS incidence was lower in year-round air-filtered herds compared to non-filtered herds throughout the year. We showed that not only the spatial risk of PRRS varies regionally according to the season of the year, but also that the effect of swine density, herd size and air filtering on PRRS incidence may also vary according to the season of the year. Further studies should investigate regional and seasonal drivers of disease. Breeding herds should maintain high biosecurity standards throughout the year.

91. Saenz RA, Hethcote HW, Gray GC. Confined animal feeding operations as amplifiers of influenza. *Vector Borne Zoonotic Dis*. 2006;6(4):338-346.
Link: Confined Animal Feeding Operations as Amplifiers of Influenza (nih.gov)
Influenza pandemics occur when a novel influenza strain, often of animal origin, becomes transmissible between humans. Domestic animal species such as poultry or swine in confined animal feeding operations (CAFOs) could serve as local amplifiers for such a new strain of influenza. A mathematical model is used to examine the transmission dynamics of a new influenza virus among three sequentially linked populations: the CAFO species, the CAFO workers (the bridging population), and the rest of the local human population. Using parameters based on swine data, simulations showed that when CAFO workers comprised 15-45% of the community, human influenza cases increased by 42-86%. Successful vaccination of at least 50% of CAFO workers cancelled the amplification. A human influenza epidemic due to a new virus could be locally amplified by the presence of confined animal feeding operations in the community.

92. 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.

93. 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.

94. 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.

95. Schultz, Amy A, Peppard, Paul, Ron E Gangnon, Kristen M C Malecki: Residential proximity to concentrated animal feeding operations and allergic and respiratory disease. *Environment International* 2019 Volume 130
Link: https://doi.org/10.1016/j.envint.2019.104911
Background: Air emissions from concentrated animal feeding operations (CAFO) have been associated with respiratory and allergic symptoms among farm workers, primarily on swine farms. Despite the increasing pre-valence of CAFOs, few studies have assessed respiratory health implications among residents living near CAFOs and few have looked at the health impacts of dairy CAFOs.
Objectives: The goal of this study was to examine objective and subjective measures of respiratory and allergic health among rural residents living near dairy CAFOs in a general population living in the Upper Midwest of the United States.
Methods: Data were from the 2008–2016 Survey of the Health of Wisconsin (SHOW) cohort (n= 5338), a re-presentative, population based sample of rural adults (age 18+). The association between distance to the nearest CAFO and the prevalence of self-reported physician-diagnosed allergies, asthma, episodes of asthma in the last12 months, and asthma medication use was examined using logistic regression, adjusting for covariates and sampling design. Similarly, the association between distance to the nearest CAFO and lung function, measured using spirometry, was examined using multivariate linear regression. Restricted cubic splines accounted for nonlinear relationships between distance to the nearest CAFO and the aforementioned outcomes.
Results: Living 1.5 miles from a CAFO was associated with increased odds of self-reported nasal allergies(OR = 2.08; 95% CI: 1.38, 3.14), lung allergies (OR = 2.72; 95% CI: 1.59, 4.66), asthma (OR = 2.67; 95% CI:1.39, 5.13), asthma medication (OR = 3.31; 95% CI: 1.65 6.62), and uncontrolled asthma, reported as an asthmaepisode in last 12 months (OR = 2.34; 95% CI: 1.11, 4.92) when compared to living 5 miles from a CAFO. Predicted FEV1 was 7.72% (95% CI:−14.63,−0.81) lower at a residential distance 1.5 miles from a CAFO when compared with a residence distance of 3 miles from a CAFO.
Conclusions: Results suggest CAFOs may be an important source of adverse air quality associated with reduced respiratory and allergic health among rural residents living in close proximity to a CAFO.

96. 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.

97. Shaw, K. A., Szablewski, C. M., Kellner, S., Kornegay, L., Bair, P., Brennan, S., Kunkes, A., Davis, M., McGovern, O. L., Winchell, J., Kobayashi, M., Burton, N., de Perio, M. A., Gabel, J., Drenzek, C., Murphy, J., Holsinger, C., & Forlano, L. (2019). Psittacosis Outbreak among Workers at Chicken Slaughter Plants, Virginia and Georgia, USA, 2018. *Emerging infectious diseases*, *25*(11), 2143–2145.
Link: https://doi.org/10.3201/eid2511.190703
During August-October, 2018, an outbreak of severe respiratory illness was reported among poultry slaughter plant workers in Virginia and Georgia, USA. A multiorganizational team investigated the cause and extent of illness, determined that the illness was psittacosis, and evaluated and recommended controls for health hazards in the workplace to prevent additional cases.

98. 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.

99. Song D, Moon H, Kang B. Porcine epidemic diarrhea: A review of current epidemiology and available vaccines. *Clin Exp Vaccine Res*. 2015;4(2):166-176. doi:10.7774/cevr.2015.4.2.166

Link: Porcine epidemic diarrhea: A review (nih.gov)
Until 2013, PED was thought to have been restricted to Asian countries. However, an outbreak of PEDV infection occurred in the United States in Iowa in April 2013, and within 1 year, PEDV had spread to Canada and Mexico, which share borders with the United States. Additionally, PED outbreaks occurred in Korea and Japan, across the Pacific Ocean, also within 1 year of the US outbreak. The PEDV strain isolated in the United States was genetically related to the Chinese PEDV strain reported in 2012. Interestingly, the Korean and Taiwanese PEDV strains isolated after the US outbreak were genetically related to the US PEDV strain.

100. 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.

101. Steinmann J. (2004). Surrogate viruses for testing virucidal efficacy of chemical disinfectants. *The Journal of hospital infection*, *56 Suppl 2*, S49–S54.
Link: https://doi.org/10.1016/j.jhin.2003.12.030
Since important agents of viral nosocomial infections like hepatitis B and C viruses and norovirus do not replicate sufficiently in cell culture systems, disinfectants with suspected efficacy against these viruses must be evaluated by different methods. Besides molecular approaches and indirect tests, the use of surrogate viruses with similar biophysical properties and genomic structure allows the assessment of virucidal efficacy of chemical disinfectants in quantitative suspension tests. Furthermore, insights into the survival of these viruses in the environment are possible.

102. Thomas, C. Estimating Water Usage on Michigan Dairy Farms. Michigan State University Extension
Link: Water Use for Large Dairies (ashland.wi.us)
Water usage on dairy farms can be divided into two general categories: 1) direct usage by dairy animals, and 2) indirect usage required for the general operation of the dairy facility.

103. Thomas, PR, et. al. (2015) Methods for Inactivating PEDV in Hog Trailers. *Animal Industry Report*: AS 661, ASL R3028.
Link: https://lib.dr.iastate.edu/ans_air/vol661/iss1/91
Contaminated livestock trailers certainly represent a significant risk for movement of the virus between and within herds. Historically, this disease risk has been effectively mitigated in some cases with the use of trailer washing, disinfection protocols, and thermo-assisted drying and decontamination (TADD) systems. This paper summarizes four studies that evaluated individual aspects of trailer sanitation programs including TADD and multiple disinfectants alone, as well several protocols that include washing, disinfection and TADD.

104. Thompson, RW. (2001) Transmission of pathogens via transportation vehicles. Retrieved from the University of Minnesota Digital Conservancy.
Link: https://hdl.handle.net/11299/147436
Outbreaks of Foot and Mouth Disease (FMD) and Classical Swine Fever (CSF) in Europe and the United Kingdom, have raised our awareness of disease transmission. Realizing how rapidly these diseases spread, industry must restrict pathogen transmission at all production levels. Our focus in this presentation will be on transportation. Because of the increasing movement of pigs in

multisite production, the economics of finishing pigs in the Midwest, plus location of the US packing industry, the chances of transmission of respiratory or enteric organisms have increased. All trucks, trailers, and other vehicles used for transporting animals, animal products, products, feed, offal, and contaminated equipment are a potential risk in the spread of disease.

105. Ueijo, C. K., et. al. (2014). Drinking water systems, hydrology, and childhood gastrointestinal illness in central and northern Wisconsin. *American Journal of Public Health*, 104(4):639- 646. Link: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4025711/

106. US Meat Export Federation. FAQ: How do Red Meat Exports Benefit the Industry? Link: FAQ : U.S. Meat Export Federation (usmef.org)

107. 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.

108. 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.

109. Weyer, P.J., J.R. Cerhan, B.C. Kross , G.R. Hallberb, J. Kantamneni, G. Breuer, M.P. Jones, W. Zheng, C.F. Lynch. 2001. *Epidemiology*, 11(3):327-338. Municipal Drinking Water Nitrate Level and Cancer Risk in Older Women: The Iowa Women's Health Study, Epidemiology: May 2001 - Volume 12 - Issue 3 - p 327-338
Link: Municipal Drinking Water Nitrate Level and Cancer Risk
Nitrate contamination of drinking water may increase cancer risk, because nitrate is endogenously reduced to nitrite and subsequent nitrosation reactions give rise to N-nitroso compounds; these compounds are highly carcinogenic and can act systemically. We analyzed cancer incidence in a cohort of 21,977 Iowa women who were 55–69 years of age at baseline in 1986 and had used the same water supply more than 10 years (87% >20 years); 16,541 of these women were on a municipal supply, and the remainder used a private well. We assessed nitrate exposure from 1955 through 1988 using public databases for municipal water supplies in Iowa (quartile cutpoints: 0.36, 1.01, and 2.46 mg per liter nitrate-nitrogen). As no individual water consumption data were available, we assigned each woman an average level of exposure calculated on a community basis; no nitrate data were available for women using private wells. Cancer incidence (N = 3,150 cases) from 1986 through 1998 was determined by linkage to the Iowa Cancer Registry. For all cancers, there was no association with increasing nitrate in drinking water, nor were there clear and consistent associations for non-Hodgkin lymphoma; leukemia; melanoma; or cancers of the

colon, breast, lung, pancreas, or kidney. There were positive associations for bladder cancer [relative risks (RRs) across nitrate quartiles = 1, 1.69, 1.10, and 2.83] and ovarian cancer (RR = 1, 1.52, 1.81, and 1.84), and inverse associations for uterine cancer (RR = 1, 0.86, 0.86, and 0.55) and rectal cancer (RR = 1, 0.72, 0.95, and 0.47) after adjustment for a variety of cancer risk/protective factors, agents that affect nitrosation (smoking, vitamin C, and vitamin E intake), dietary nitrate, and water source. Similar results were obtained when analyses were restricted to nitrate level in drinking water from 1955 through 1964. The positive association for bladder cancer is consistent with some previous data; the associations for ovarian, uterine, and rectal cancer were unexpected.

110. 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/

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.

111. Wilson SM, Serre ML. Examination of atmospheric ammonia levels near hog CAFOs, homes, and schools in eastern North Carolina. *Atmos Environ* 41(23):4977–4987 (2007)
Link: http://dx.doi.org/10.1016/j.atmosenv.2006.12.055

Hog concentrated animal feeding operations (CAFOs) release ammonia (NH_3) in Eastern North Carolina (NC) to the atmosphere which is potentially hazardous for nearby human populations at community locations particularly homes and schools. We present NH_3 weekly average concentrations that were collected using passive diffusion tubes from October 2003 to May 2004 (20 sites) and from July 2004 to October 2004 (23 sites) near community locations in close proximity to hog CAFOs. The data for each phase of sampling was stratified by distance from the nearest hog CAFO. The mean Phase I levels were 16, 8, 7 and 5 ppb for distances <0.5, 0.5-1, 1-

2, and 2 km or more, respectively. The mean levels for Phase II were 29, 16, and 11 ppb for distances <0.5, 0.5-1, and 1 km or more, respectively. The results of the distance stratification are the best results of this study and provide the strongest evidence that distance to one or more CAFOs is the key variable in controlling weekly NH_3 atmospheric concentration at the community level in Eastern NC. Statistical analyses confirmed that source terms such as distance to a hog CAFO and live weight per operation, as well as temperature, wind speed and wind direction were important predictors of atmospheric NH_3 at community locations. The results indicate potential zones of exposure for human populations who live or go to school near hog CAFOs.

112. Wing 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.

113. 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.

114. Woods, J. et.al. (2008). Fatigue: a major cause of commercial livestock truck accidents. *Veterinaria italiana*, *44*(1), 259–262.
Link: Woods 259-262.doc (izs.it)
Accident reports on 415 commercial livestock truck accidents were tabulated between 1994 and June 2007 in the United States and Canada. Data was collected from Google internet searches of newspaper and television news reports, unpublished industry sources and Alberta government agencies. Fifty-nine percent of the accidents occurred during the early morning hours from midnight to 9:00 am and 80% involved a single vehicle. Driver error was blamed for 85% of the wrecks. In 83% of the accidents, the vehicle rolled over and 84% of the truckers tipped over on their right side. In North America, vehicles travel on the right-hand side of the road and if a driver falls asleep at the wheel he usually drifts off toward the right. Driver fatigue is the most likely explanation for many of these accidents.

University Programs

115. Drake University Agricultural Law Center. Manure Agreement Decision Making Tool
Link: Drake Decision Making Tool

116. Iowa State University, Center for Food Security and Public Health, 2021 *Protecting Your Herd/Flock Biosecurity Tip Sheet.*
Link: https://www.cfsph.iastate.edu/Assets/tip-sheet-protecting-your-herd-flock.pdf

This sheet describes basic biosecurity practices to keep disease out of a facility, and to avoid transport of disease within a facility or to the outside of a facility

117. University of Minnesota. Pitkin, A. Biosecurity protocols for the prevention of spread of porcine reproductive and respiratory syndrome. Swine Disease Eradication Center.
Link: Biosecurity protocols for the prevention of PRRS
Preventing the spread of PRRSV within and between pig populations is a critical component of a farm's disease control program. To aid in controlling the spread of this agent, this manual provides a summary of data from experiments conducted from our group at the University of Minnesota that were specifically designed to identify the routes of PRRSV transmission and to develop protocols of biosecurity to reduce this risk. All protocols have been, and continue to be validated during an ongoing experiment that has been in process over the past 2 years at our Swine Disease Eradication Center (SDEC) production region model farm.

118. University of Minnesota. Enhanced Passive Surveillance for ASF and CSF. *Swine in Minnesota*. September 24, 2021
Link: Enhanced Passive Surveillance for ASF and CSF
Center for Animal Health and Food Safety at the University of Minnesota shares preliminary results regarding a project looking at enhanced surveillance for two Foreign Animal Diseases: African Swine Fever and Classical Swine Fever.

119. University of Minnesota. Operation Guidance Manual for Harvest Facilities during FAD/EDI Investigations. October 2015
Link: Operation Guidance Manual for Harvest Facilities
This document provides guidance for livestock harvesting facilities operating during a foreign animal disease (FAD) or an emerging disease incident (EDI) investigation. Includes Issues for Consideration and General Recommendations for Facilities. Outlines actions that a facility can take to better prepare for a potential FAD/EDI, while considering individual facility needs and continuity of business concerns, as well as concerns about potential disease spread.

120. University of Minnesota. Risk Assessment for the Transmission of Foot and Mouth Disease via Movement of Swine and Cattle Carcasses from FMD-infected Premises to a Disposal Site. February 18, 2014.
Link: Carcass Movement RA Final UMN
Time for disease detection was estimated by a disease spread model to be between 4-10 days for swine and beef cattle and 3-9 days for dairy cattle premises of different sizes. Total time from infection to depopulation (including detection and confirmation) for the first FMD infected case was estimated to be between 10-15 days for swine, 8-12 days for dairy and 10-14 days for beef cattle premises. The average concentration of FMDv in a carcass in experimental inoculation studies was 103 Plaque Forming Unit per gram (PFU/g) for a pig carcass and 106 PFU/g for a cattle carcass. The total amount of infected carcasses moved to the disposal site (relative to the size of the animal carcass and the capacity of the truck trailer) was between 23-390 cattle carcasses and 117-780 pig carcasses per truck. Any small amount of body fluids (1 mL) would contain virus that is equal and greatly exceeds the infective dose by oral and inhalation route for pigs and cattle. The likelihood that swine and cattle carcasses moved from FMD positive premises will contain an infective dose was high. The use of a Bio-Zip™ bag in a standard rendering truck (tailgate sealed and tarp cover) reduces the likelihood of leakage, spillage and aerosolization to negligible.

121. University of Minnesota. Newly funded: Investigating swine industry biocontainment strategies for airborne diseases. August 27, 2021
Link: Swine industry biocontainment strategies for airborne diseases
Airborne animal diseases in today's agricultural settings are difficult to contain. Let's say a pig raised in confinement with other swine contracts porcine reproductive and respiratory syndrome virus (PRRS); more than likely, the swine are in a controlled ventilated environment, where exhaust fans move airborne particles to the outdoors. In short order, air containing PRRS virus will flow into the environment and potentially to the swine farm across the road, causing an outbreak. How could the outbreak have been contained?

122. University of Minnesota Extension. Odor From Feedlots Estimation Tool (OFFSET).
Link: offset-users-guide.pdf
The amount of odor emitted from a particular farm is a function of animal species, housing types, manure storage and handling methods, the size of the odor sources, and the implementation of odor control technologies. However, the impact of these odors on the surrounding neighborhood or community is a function of both the amount of odor emitted and the weather conditions. Weather conditions strongly influence the movement and dilution of odors. Odor impact includes the strength of the odors and the frequency and duration of the odor events. OFFSET combines odor emission measurements with the average weather conditions to estimate the strength and frequency of odor events at various distances from a given farm.

123. University of Missouri. Securing Manure Spreading Rights through Easements. *Agricultural MU Guide.* G-361
Link: G0361_03.qxd (missouri.edu)
Several trends in modern animal agriculture are causing people to look at easements as a legal tool to help them meet their business objectives. Animal feeding operations are getting larger, and animals are housed in facilities engineered to capture and store manure. These larger animal feeding operations are highly specialized, sometimes owning less land than would be necessary to use the manure agronomically. Another trend is an increase in environmental regulation affecting many of these animal feeding operations. Recent concerns over the environmental impacts of animal feeding operations have led to new regulations. These trends often create a need to regularly export manure to neighboring farms; easements can be used to formalize this arrangement.

124. University of Wisconsin. **S**oil **N**utrient **A**pplication **P**lanner (SnapPlus)
Link: SnapPlus – Wisconsin's Nutrient Management Planning Software
SnapPlus is a Nutrient Management Planning software program designed for the preparation of nutrient management plans in accordance with Wisconsin's Nutrient Management Standard Code 590. SnapPlus will calculate:

- Crop nutrient (N, P_2O_5, K_2O) recommendations for all fields on a farm taking into account legume N and manure nutrient credits consistent with University of Wisconsin recommendations
- A RUSLE2-based soil loss assessment that will allow producers to determine whether fields that receive fertilizer or manure applications meet tolerable soil loss (T) requirements.
- A rotational Phosphorus Index value for all fields as required for using the P Index for phosphorus management.
- A rotational P balance for using soil test P as the criteria for phosphorus management.

Regulatory & Court Documents

125. California Department of Food and Agriculture. Proposition 12 Implementation Plan.
Link: CDFA - Proposition 12 Implementation (ca.gov)

126. California Environmental Protection Agency, Regional Water Quality Control Board, Central Valley Region, 2010*, Groundwater Quality Protection Strategy Central Valley Region "Roadmap"*
Link:https://www.waterboards.ca.gov/centralvalley/water_issues/groundwater_quality/2010aug_gwq_protect_strat_approved.pdf

Section 4.1 Confined Animal Facilities Page 34-35, Dairy General Order established a schedule for dischargers to develop and implement measures protective of water quality and confirm protection of groundwater quality through monitoring. Requirements of the General Order were phased to allow a systematic approach for implementation of regulatory measures recognizing available resources on behalf of dischargers, consultants, and the Central Valley Water Board. Measures required by the General Order are for both the dairy production area and land application area and include development of a Nutrient Management Plan by July 2009 with full implementation by 2012 and development of a Waste Management Plan by July 2010 and full implementation by 2012. The Dairy General Order requires each Discharger to immediately begin sampling each of the domestic and agricultural wells present at the dairy and discharges from any subsurface (tile) drains. Groundwater monitoring at existing dairies is necessary to: determine background groundwater quality; determine existing groundwater conditions near retention ponds, corrals, and land application areas; determine the effect of the improved management practices required in the Dairy General Order On groundwater quality.

127. Food & Water Watch. Octo 26, 2021. *Petition to Rescind the Air Consent Agreement and Enforce Clean Air Laws Against Animal Feeding Operations.*
Link: FINAL EPA Petition re 2005 Air Consent Agreement.docx (foodandwaterwatch.org)

Over sixteen years ago, the Environmental Protection Agency (EPA), announced an Agreement and Final Order it had secretly negotiated with the National Pork Producers Council. In the agreement, EPA refrained from enforcing key air pollution control and public disclosure laws against any animal feeding operation (AFO) that agreed to pay a nominal penalty to fund a nationwide air monitoring program to establish Emission Estimating Methodologies (EEMs) for AFOs. Nearly 14,000 AFOs signed up for this deal, known as the Air Consent Agreement. We ask that you rescind the Air Consent Agreement, enforce all applicable laws against AFOs, and prioritize environmental justice in enforcement and climate actions.

128. Minnesota Department of Transportation Research Services & Library. August 2014, *Assessing the Effects of Heavy Vehicles on Local Roadways.*
Link: https://www.lrrb.org/pdf/201432.pdf

This report documents the development of an analysis procedure and an associated computation tool to estimate the impact of heavy vehicles on local agency pavements. The heavy vehicles of interest are those which were not anticipated at the time the pavement structure was designed, but which cause additional damage and thus create the need for rehabilitation or reconstruction sooner than expected, including pork farms. The tool described in this report implements the procedure, and provides users with the ability to analyze a single roadway segment (for detailed impacts estimates) or an agency's entire network (for summary statistics over the system). The tool is contained in a macro-enabled Microsoft Excel spreadsheet and does not need additional files or external functionality to conduct an analysis.

129. Minnesota Pollution Control Agency. Implementation Plan for the Lake St, Croix Nutrient TMDL. February 2013 Appendix B Polk County Page 1
Link: Implementation Plan Lake St. Croix TMDL (state.mn.us)

The TMDL allows for 108,000 lbs/yr of phosphorus to be loaded to the St. Croix River from Polk County. This requires 53,000 lbs/yr of reduction from the estimated TMDL baseline load of 161,000 lbs/yr in the early 1990s. Polk County's required reduction ranks 1st largest among the 19 counties in the basin. To achieve the St. Croix Basin Partners' goal of 20% reduction by 2020, Polk County needs to reduce loadings by 39,000 lbs/yr by the year 2020. To attain this goal, activities must be implemented that achieve an average annual rate of phosphorus reduction of 1,300 lbs/yr over 30 yrs, or 3,900 lbs/yr over 10 yrs.

130. Minnesota Pollution Control Agency. Lake St. Croix Nutrient Total Maximum Daily Load (TMDL) May 2012
Link: Lake St Croix_TMDLFinalReport.pdf
The St. Croix River and Lake St. Croix are highly valued resources that provide exceptional recreational opportunities and support a highly diverse ecology of aquatic and terrestrial species. However, over the years eutrophication, or nutrient enrichment, has occurred in Lake St. Croix due to excess phosphorus loading. This loading drives nuisance algae blooms which diminish the enjoyment and use of the lake. This report represents an important step in the improvement of Lake St. Croix by focusing on establishing the needed reduction in the loading of phosphorus from its contributing basin in order to achieve water quality standards.

131. National Fire Protection Association. NFPA 1141 Standard for Fire Protection Infrastructure for Land Development in Wildland, Rural, and Suburban Areas. 2017
Link: NFPA 1141: Standard for Fire Protection for Wildland, Rural, and Suburban Areas
Provides requirements for the development of fire protection and emergency services infrastructure to make sure that wildland, rural, and suburban areas undergoing land use changes or land development have the resources and strategies in place to protect people and property from fire dangers, and allow fire fighters to do their jobs safety and effectively.

132. National Fire Protection Association. NFPA 1142 Standard on Water Supplies for Suburban and Rural Fire Fighting. 2022
Link: NFPA 1142: Standard on Water Supplies for Suburban and Rural Firefighting
An adequate and reliable municipal-type water supply is sufficient every day of the year to control and extinguish anticipated fires in the jurisdiction. NFPA 1142 identifies minimum standards to assist rural and suburban fire departments in developing sufficient water supplies where no in-ground hydrant system, or an inadequate one, exists. Provides methods for determining water supply requirements based on occupancy and construction classifications. Also provides information regarding apparatus construction for water tankers.

133. National Fire Protection Association. NFPA 1144 Standard for Reducing Structure Ignition Hazards from Wildland Fires. 2018
Link: NFPA 1144: Standard for Reducing Structure Ignition Hazards from Wildland Fire
This standard provides a methodology to assess wildland fire ignition hazards around existing structures and new structures located in wildland interface areas. Also provides minimum requirements for new construction to reduce the potential of structure ignition from wildland fires.

134. National Fire Protection Association. NFPA 150 Fire and Life Safety in Animal Housing Code. 2022
Link: https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=150

This code provides the minimum requirements for the design, construction, fire protection, and classification of animal housing facilities.

135. North Carolina Department of Environmental Quality. Title VI: Increasing Equity, Transparency, and Environmental Protection in the Permitting of Swine Operations. Attachment C: Updated Odor Control Checklist May 4, 2020
Link: Updated Odor Control Checklist.pdf

136. Polk County Extension - University of Wisconsin. Sample Manure Management Agreement.
Link: Manure Management Agreement (wisc.edu)

137. Polk County, Wisconsin Board of Supervisors. Resolution 39-21Urging the State of Wisconsin to Adequately Fund State Agencies Regarding CAFO Regulations to Protect Groundwater and Air Quality. August 21, 2021.
Link: Polk County Resolution No 39-21
The Polk County Board of Supervisors hereby urges the State of Wisconsin to adequately fund the Department of Natural Resources and the Department of Agriculture, Trade and Consumer Protection so they can vigorously monitor and regulate all of the existing and future CAFOs to the fullest extent of its authority. Supervisors urge the State Legislature and the Governor to fully fund the various regulatory agencies so that they have the resources they need to adequately monitor and regulate CAFOs.

138. Polk County, Wisconsin Board of Supervisors. Resolution 03-20 Extending Moratorium on Swine CAFOs. February 20, 2020.
Link: Resolution 03-20 Extending CAFO_Moratorium
Limits research into making swine CAFOs a conditional use for areas subject to the Shoreland Use Ordinance. Includes no Findings of Facts.

139. Polk County, Wisconsin Board of Supervisors. Resolution 37-20 Swine CAFO Amendment. September 15, 2020
Link: Resolution 37-20 Amended Polk County ComprehensiveLandUse
Targets swine CAFO development in towns with areas zoned Agriculture-20 and non-shoreland lands in un-zoned towns such as Laketown. CAFO developments with 2,499 hogs or less (1,000 animal units) in zoned towns also have no restrictions. Developers interested in non-shoreland areas of Laketown have no county siting restrictions. Manure from CAFOs in un-zoned areas can be spread in shoreland areas throughout the county.

Developers planning more than 2,499 hogs (1,000 animal units) in zoned towns must be in areas zoned Agriculture-20. In addition, they are required to get a conditional use permit through the county's Environmental Services Committee that will include at least the following provisions:

a. **Setbacks -** 200' setback for waste storage and housing for an infinite number of hogs. 100' setback for driveway entrance.
b. **Waste -** Requires nutrient and mortality management plans.
c. **Overweight Loads -** Requires town approval during spring break-up.
d. **Spills -** Developers **s**hall notify the town and county of spills within 24 hours. The county will publically notice the spill.
e. **Previous livestock violations** - Violations by the owner/parent company must be reported

f. **Suspected hazards** - Environmental or human health hazards must be referred to the county.
g. **Residency** - Owner or operator must live within five (5) miles of the development.
h. **Plans** - Professionally designed and drafted plans required for the main facility.

This swine CAFO ordinance was developed during a 12-month moratorium that required the county to study a wide range of environmental and health issues. This was supposed to be done because Wisconsin law requires ordinances to be based on "reasonable and scientifically defensible findings." However, the county did not do the needed work and provided no findings. As a result, DATCP staff issued a letter to the county that the ordinance is vulnerable to legal challenge.

140. St. Croix County, Wisconsin Community Development Committee (CDC). February 20, 2020 letter to Wisconsin DNR
Link: SCC-CDC-letter-to-DNR-ESD-2020.pdf
The documented violations and citizen concerns together are the reason this letter was prepared. Along with close scrutiny of the WPDES re-authorization application, CDC asks that additional measures and accountability be included in WPDES Permit 00593315-04-0 if the DNR chooses to re-issue the permit to Emerald Sky Dairy. The CDC requests full and quick enforcement of manure application rules and statutes for CAFO's located in St. Croix County. According to the Wisconsin Land and Water Conservation Association, loss of nutrients from cropland and pastures is the largest source of nonpoint source nutrient pollution in surface and groundwater in Wisconsin.

141. Town of Laketown, Polk County, Wisconsin. Town of Laketown Comprehensive Plan. October 27, 2009
Link: Town of Laketown Comprehensive Plan
In July of 2007 Polk County, along with twenty-five of its municipalities, was awarded a multi-jurisdictional Comprehensive Planning Grant through the Wisconsin Department of Administration to develop Comprehensive Plans. The Town of Laketown participated in the grant and began working on the plan in September of 2007. In order to review the issues and opportunities unique to the Town of Laketown, the following will be addresses.

142. Town of Laketown, Polk County, Wisconsin. Moratorium on Livestock Facility Licensing Committee Report. December 22, 2020
Link: Laketown Livestock Facility Report
Study, review, consider and determine whether amendments to the Large Scale Development Ordinance or the creation of a Livestock Facilities Licensing Ordinance or other ordinances are required to protect the environment, public health or safety and property in Laketown Township in light of the unique environment and the key concerns identified in the Town of Laketown Comprehensive Plan.

143. United Nations Food and Agriculture Organization. 2020 Global control of African swine fever - 2020 to 2025. Paris
Link: Global control of African swine fever (fao.org)

144. United States Department of Agriculture. Mass Depopulation & Euthanasia- Swine Euthanasia. *Powerpoint slide show*
Link: mde_swine_presentation.pptx (live.com)

145. United States Department of Agriculture. Mass Depopulation & Euthanasia- Avian Euthanasia. *Powerpoint slide show*
Link: mde_avian_presentation.pptx (live.com)

146. United States Department of Agriculture. Depopulation, Disposal and Decontamination Consideration for African Swine Fever. August 13, 2019.
Link: Depopulation, et al for African Swine Fever
This webinar began with a discussion of lessons learned from past outbreaks presented by Mike Starkey of the Minnesota Department of Agriculture. Lori Miller of USDA then presented an overview of depopulation, disposal, and decontamination considerations and tools related to African swine fever. Dr. Mike Neault of North Carolina Department of Agriculture and Consumer services wrapped up the webinar with a presentation regarding activities that have occurred, our readiness at present, and what still needs to be accomplished.

147. United States Department of Agriculture. African Swine Fever Information
Link: USDA APHIS | African Swine Fever (ASF) Information
African swine fever is a highly contagious and deadly viral disease affecting both domestic and feral swine of all ages. ASF is not a threat to human health and cannot be transmitted from pigs to humans. It is not a food safety issue. ASF is found in countries around the world, particularly in sub-Saharan Africa. More recently, it has spread through China, Mongolia and Vietnam, as well the European Union, Dominican Republic and Haiti.

148. United States Department of Agriculture. African Swine Fever Herd Plan: Euthanasia, Depopulation, Disposal, & Virus Elimination Procedures. November 2020
Link: ASF Domestic Herd Plan
This African Swine Fever Herd Plan template is intended to serve as a guide. It must be amended as necessary to be specific to the single premises identified below.

149. United States Department of Agriculture. ASF Action Week September 2021.
Link: USDA APHIS | ASF Action Week Webinar
The USDA invites you to join us September 13-17, 2021 for daily webinars to learn more about African swine fever and its global spread, actions being taken to safeguard the United States, and biosecurity measures you can implement now to protect the U.S. herd. Recorded sessions are available.

150. United States Department of Agriculture. African Swine Fever- An Unwelcome Arrival in Germany. *Foreign Agricultural Service Report*. Number: GM2020-0052. September 10, 2020.
Link: FAS Report GM2020-0052
On September 10, Germany's Federal Minister of Food and Agriculture confirmed a case of ASF in a wild boar found near the German-Polish border in the village of Sebtem, Spree-Neiße district. This is the first ASF case in Germany and it was only a matter of time especially given the recent rise of cases in Western Poland. The risk of introducing the pathogen into Germany was rated as high according due to the proximity to the border of the latest Polish cases. However, an introduction by humans via contaminated food cannot be excluded. On-site ASF control measures are being conducted by the general veterinary authorities and the Provincial Crisis Management Center. A fence is now being erected around a 4 km radius of the site where the infected wild boar was found. Samples taken from bones of the decomposing carcass of the wild boar suggest that ASF entered Germany several weeks ago, indicating that additional ASF detections are likely. Search parties are looking for more dead boar carcasses in the area.

151. United States Department of Agriculture Foreign Agriculture Service. 2020 U.S. Agricultural Export Yearbook.
Link: 2020-ag-export-yearbook.pdf (usda.gov)
Provides a statistical summary of U.S. agricultural commodity exports to the world. The 16 product groups or commodity aggregations, displayed in the Yearbook, are based on the United States' largest export categories. The United States' top 15 export destinations are included as well as a page for the United Kingdom (UK). The European Union (EU27+UK), a customs union comprised of 28 member states, is included as a single trading partner. The only exception is that the UK has its own yearbook page given the importance of its withdrawal from the EU-28. The top 14 export markets represent 80 percent of total U.S. agricultural exports in 2020.

152. United States Department of Agriculture - Secretary Vilsack Message on African Swine Fever.
Link: African Swine Fever Message from USDA Secretary Tom Vilsack
African swine fever (ASF) is a highly contagious and deadly viral disease affecting both domestic and feral swine of all ages. ASF has never been found in the United States – and we want to keep it that way. ASF is a devastating, deadly disease that would have a significant impact on U.S. livestock producers, their communities and the economy if it were found here. There is no treatment or vaccine available for this disease.

153. United States Department of Transportation, Federal Highway Administration, *Developing Safety Plans, A Manual for Local Rural Road Owners.* March 2012
Link: https://safety.fhwa.dot.gov/local_rural/training/fhwasa12017/
Over three-fourths of all road miles in the U.S. are in rural areas. Of those three million miles of rural roads, almost 80 percent are owned and operated by local entities. In 2009, rural roads accounted for approximately 33 percent of the vehicle miles traveled in the U.S.3, but 56 percent of fatalities. Local roads in rural areas may have design elements that increase the risk of fatalities or serious injuries, such as inappropriately high speed limits, narrow lane widths and shoulders, steep ditches, or trees close to the roadway. Additionally, the low population density and sparse land use of rural communities can increase detection, response, and travel times for emergency services, reducing key factors in crash survivability. It typically takes more than twice as long for emergency services to arrive at a crash scene in a rural community compared to an urban community. Recommendations for developing a Local Road Safety Plan include: defining specific areas of emphasis to evaluate: eg, intersection safety, speed management, hazardous locations, and roadway/lane departures. Evaluation of specific hazards may include engineering evaluation to be sure the roads will meet the needs of heavier and more frequent truck traffic related to the CAFO.

154. United States Environmental Protection Agency. *Carcass Management of Non-Diseased Animals in Response to the Coronavirus Outbreak.*
Link: Carcass Management in Response to the Coronavirus (Covid-19) Outbreak
Help for producers and facilities with non-diseased carcass management during the current Coronavirus outbreak (COVID-19). Due to Covid-19, animal production and processing facilities are encountering challenges associated with certain livestock and poultry processing plant closures due to workforce and staffing issues related to the COVID-19 outbreak at those plants. As a result of these shutdowns, and other factors, some animal production facilities may need to depopulate by euthanizing animals. Unlike mortalities at normal rates, large-scale mortalities present challenges that are not part of the typical operation of these facilities. Operators are typically advised to have plans for emergency large-scale mortalities; for example, due to extreme weather or disease. However, those plans may be insufficient given the extensive challenges being faced at the current time.

155. United States Environmental Protection Agency. Sept 2017. *Eleven Years After Agreement, EPA Has Not Developed Reliable Emission Estimation Methods to Determine Whether Animal Feeding Operations Comply With Clean Air Act and Other Statutes.* 7-P-0396
Link: Eleven Years After Agreement
Until the EPA develops sound methods to estimate emissions, the agency cannot reliably determine whether animal feeding operations comply with applicable Clean Air Act requirements.

156. United States Environmental Protection Agency. *Exposure Assessment of Livestock Carcass Management Options During a Foreign Animal Disease Outbreak.* April 2018
Link: Exposure Assessment of Livestock Carcass Management
Evaluation of livestock carcass management options following a foreign animal disease outbreak. This assessment helps to inform a scientifically-based selection of environmentally protective methods. If carcasses cannot be managed immediately after death, the temporary carcass storage pile appears to be the most likely source to possibly expose nearby livestock. This assessment estimates livestock exposure to FMDv released from a temporary storage pile where carcasses are placed for 48 hours while further management is prepared. The assessment also considers seven well-established carcass management options with sufficient capacity for a large-scale mortality: on-site open burning (pyre), on-site air-curtain burning, on-site unlined burial, on-site composting, off-site fixed-facility incineration, off-site landfilling, and off-site carcass rendering

157. United States Environmental Protection Agency. *Handbook Groundwater and Well Head Protection.* EPAl625/R-94/001 September 1994
Link: 30004NCA.PDF (epa.gov)
Anyone responsible for delineating the boundaries of a wellhead protection area, Identifying and evaluating potential contaminants, and Identifying wellhead management options Will find the handbook useful. Most of this handbook does not require specialized training in hydrogeology. Basic math skills, including high school-level algebra, are required.

158. United States Environmental Protection Agency. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019.* May 2021 pages 5-1 to 5-59.
Link: Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019
Agricultural activities contribute directly to emissions of greenhouse gases through a variety of processes. Chapter 5 of the report assesses methane (CH4) and nitrous oxide (N2O) emissions from enteric fermentation in domestic livestock, livestock manure management, rice cultivation, agricultural soil management, and field burning of agricultural residues; as well as carbon dioxide (CO2) emissions from liming and urea fertilization.

159. 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.

160. United States Environmental Protection Agency, *National Management Measures to Control Nonpoint Source Pollution from Agriculture,* EPA 841-B-004, July 2003
Link: https://www.epa.gov/nps/monitoring-guidance-determining-effectiveness-nonpoint-source-controls.
This Guidance addresses design of water quality monitoring programs to assess impacts from nonpoint source pollution (including agriculture) and evaluate success of control practices and management measures. Since each situation is different, this guidance presents the theory and information needed to design monitoring programs tailored to particular situations.

161. United States Environmental Protection Agency. *NPDES Permit Writers' Manual for CAFOs.* February 2021
Link: NPDES Permit Writers' Manual for CAFOs
Provides information to National Pollutant Discharge Elimination System (NPDES) permit writers on permitting requirements for Concentrated Animal Feeding Operations (CAFOs). The information in the Manual may also be useful for inspectors, facility operators, and the general public. Under the Clean Water Act (CWA), it is unlawful to discharge any pollutant from a point source without an NPDES permit. The CWA defines point source to include "any discernible, confined, and discrete conveyance, including but not limited to any … concentrated animal feeding operation … from which pollutants are or may be discharged." Under the NPDES CAFO regulations, a CAFO that discharges must seek NPDES permit coverage.

162. United States Environmental Protection Agency. *Relation between nitrates in water wells and potential sources in the lower Yakima Valley, Washington state*. Washington, D.C., 2012.
Link: Relation between Nitrates in Water Wells and Potential Sources in the Lower Yakima Valley, Washington (epa.gov)
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.

163. United States Environmental Protection Agency. *Risk Assessment Evaluation for Concentrated Animal Feeding Operations.* May 2004: 1-124.
Link: US EPA Risk Management Evaluation For Concentrated Animal Feeding Operations
The National Risk Management Research Laboratory (NRMRL) developed a Risk Management Evaluation (RME) to provide information to help plan research dealing with the environmental impact of concentrated animal feeding operations (CAFOs). Methods of animal production in the U.S. have undergone fundamental changes in the last 30 years. The majority of meat, dairy, and poultry production has been concentrated into large facilities. Dairies with more than 2,000 cows and swine operations with more than 10,000 hogs are not unusual. Broiler houses with 50,000 birds are common. With the concentration of animals has come a concomitant concentration of manure production. One animal facility with a large population of animals can easily equal a small city in terms of waste production. Current practices of waste handling often include minimal or no treatment before the wastes are disseminated into the environment. The RME was

developed to provide characterization of the waste problem, and a description of common environmental stressors and their movement including the air transport of pollutants. Current risk management practices in the animal industry are described, along with treatment approaches such as anaerobic/aerobic digestion, constructed wetlands, and disturbed land reclamation. Finally, suggested areas for future research are presented to help focus planning for the near future.

164. United States Environmental Protection Agency. April 19, 2013. *SAB Review of Emissions-Estimating Methodologies for Broiler Animal Feeding Operations and for Lagoons and Basins at Swine and Dairy Animal Feeding Operations.*
Link: EPA-SAB-13-003
This Science Advisory Board (SAB) report responds to a request from the EPA's Office of Air and Radiation (OAR) to review and provide advice on scientific issues associated with development of Emissions-Estimating Methodologies (EEMs) at two types of animal feeding operations (AFOs): EEMs for barns or buildings at confined broiler AFO facilities and an EEM for open lagoons and basins at swine and dairy AFO facilities. EEMs are tools for estimating air pollutant emissions from industries where site-specific emissions data are not available.

165. United State House of Representatives - Select Subcommittee on Coronavirus Crisis. Coronavirus Infections and Deaths Among Meatpacking Workers at Top Five Companies Were Nearly Three Times Higher than Previous Estimate. October 27, 2021
Link: 2021.10.27 Meatpacking Report.Final_.pdf (house.gov)
Newly obtained documents from five of the largest meatpacking conglomerates, which represent over 80 percent of the market for beef and over 60 percent of the market for pork in the United States—JBS USA Food Company (JBS), Tyson Foods, Inc. (Tyson), Smithfield Foods (Smithfield), Cargill Meat Solutions Corporation (Cargill), and National Beef Packing Company, LLC (National Beef)—reveal that coronavirus infections and deaths among their meatpacking workers were substantially higher than previously estimated.

166. Wisconsin Attorney General. AG Kaul Announces $86,000 Agreement with Jon-De Capital, Inc. for Violations of Wisconsin's Wastewater Laws. October 1, 2021
Link: AG Kaul Announces $86,000 Agreement with Jon-De Capital

167. Wisconsin Circuit Court - St. Croix County Case no. 2019-000002. State of Wisconsin vs Emerald Sky Dairy. May 3, 2019.
Link: Circuit court St. Croix 2019-000002

168. Wisconsin Department of Agriculture Trade and Consumer Protection. Livestock Facility Siting Technical Expert Committee Four-Year Review of ATCP 51, April 23, 2019
Link: LivestockSitingTECReport2019.pdf (wi.gov)
The 2019 Technical Expert Committee (TEC) was convened as part of the Department of Agriculture Trade, and Consumer Protection's required four year review of the livestock facility siting standards under ch. ATCP 51, Wis. Admin. Code. The recommendations in this report reflect the consensus of the TEC on the issues presented for their consideration. The committee's recommendations are arranged according to the following issues: Odor Management and Setbacks, Manure and Other Waste Storage, Runoff Management, Monitoring, Completeness Determinations and Permit Modifications, and Groundwater Protections.

169. Wisconsin Department of Agriculture Trade and Consumer Protection. Chapter ATCP 10. Animal Disease and Movement.

Link: Wisconsin Legislature: Chapter ATCP 10

170. Wisconsin Department of Agriculture Trade and Consumer Protection. Chapter ATCP 93.90 Livestock Facility Siting and Expansion
Link: Wisconsin Legislature: Chapter ATCP 93.90

171. Wisconsin Department of Agriculture Trade and Consumer Protection. Wi Admin. Code Ch. ATCP 51
Link: Wisconsin Legislature: Chapter ATCP 51

172. Wisconsin Department of Agriculture Trade and Consumer Protection. Animal Movement
Link: DATCP Animal Movement (wi.gov)
This information provides general rules for importing any animal into Wisconsin. Species-specific information and other references regarding the movement of animals are listed.

173. Wisconsin Department of Agriculture Trade and Consumer Protection. Runoff Risk Advisory Forecast.
Link: Runoff Risk Advisory Forecast (wi.gov)
The tool helps determine the potential for manure runoff from a field depending on weather conditions and soil temperature. Spreading manure when there is an elevated risk of runoff can send manure into streams and threaten water quality.

174. Wisconsin Livestock Facility Siting Rule modifies Wis. Admin. Code Ch. ATCP 51 (Final Draft Rule), October 24, 2019.
Link: ProposedATCP51FinalDraftRulePacket.pdf (wi.gov)
• Reflects revisions necessary to address the technical and implementation issues raised through three 4-year technical committee review processes, twelve statewide public hearings including verbal testimony from over 160 Wisconsin citizens and 465 written comments submitted to the department, as well as dozens of conversations with interested and potentially impacted parties to arrive at workable compromise to achieve multiple, diverse goals.
• Updates the water quality standards, including related Natural Resources Conservation Service (NRCS) technical standards, to ensure consistency with provisions in NR 151 and ATCP 50, including incorporation of the 2017 NRCS standard for waste storage structures, 2015 NRCS standard for nutrient management, the 2017 NRCS standard for waste treatment, and the 2016 NRCS standard for vegetated treatment areas.
• Modifies standards (subch. II of ATCP 51) consistent with the requirements in Wis. Stat. § 93.90(2), based on the technical recommendations of the 2014 and 2018 Technical Expert Committees and public input. Key changes include modifications to setback and odor standards.
• Modifies the procedures (subchs. I and III of ATCP 51) that local governments must follow in issuing a siting permit under a zoning or licensing ordinance including application completeness determinations, permit modifications, and the use of checklists to monitor facility compliance.
• Modifies local permit application forms and worksheets to reflect changes in requirements and to ensure that they are clear, complete, and elicit information that documents compliance with applicable siting standards.
• Makes other changes, clarifications and updates as necessary to improve implementation of the siting rule, consistent with the requirements in Wis. Stat. § 93.90(2).

175. Wisconsin Department of Agriculture Trade and Consumer Protection. Memo on Polk County Swine CAFO ordinance. August 2020
Link: f3e1b58a-f0a9-42be-a7e5-023bb772e8a7.pdf

Wis. Stats 93.90(3) does not grant the authority to political subdivisions to disapprove a permit based on species. Therefore, it cannot regulate only those livestock facilities that house swine... The proposed ordinance requires compliance with several more stringent local standards, identified as Section 10.4.6(C)(2) criteria; a, b, c, d, e, g, i, j, k, l, m, p. These more stringent standards do not meet all of the conditions laid out by ATCP 51.10(3). If the county wishes to adopt more stringent local standards than those included in ATCP 51, it must base those standards on reasonable and scientifically defensible findings of fact adopted by the county's governing authority and clearly show that those standards are needed to protect public health or safety...

176. Wisconsin Department of Natural Resources. Beneficial Management Practices for Mitigating Hazardous Air Emissions. December 13, 2010
Link: Recommended Beneficial Management Practices
Report from the Agricultural Waste Air Emissions Advisory Group identifies and recommends suitable best management practices (BMPs) for the reduction of emissions of hazardous air pollutants from various types of livestock operations in Wisconsin. Report focuses on two hazardous air contaminants: ammonia and hydrogen sulfide. As part of the development of 30 BMPs specific to ammonia and hydrogen sulfide, air quality co-benefits and potential impacts to water quality were identified.

177. Wisconsin Department of Natural Resources. CAFO Applications within Surface Water Quality Management Areas (SWQMA) NR 243 – CAFO Factsheet #1
Link: NR 243 – CAFO Factsheet #1
CAFO permits do not prohibit applications of manure and process wastewater within the SWQMA. However, CAFOs must take additional precautions when applying manure or process wastewater within the SWQMA. One option when applying manure within the SWQMA is to maintain a 100-foot setback from navigable waters and their conduits. Another option is to implement practices equal to or better than the 100-foot setback. There are other options which an operation can use to reduce the 100-foot setback to 25 feet on fields that have been in long-term no-till.

178. Wisconsin Department of Natural Resources. NR 151 Rule Changes for Nitrate
Link: NR 151 rule changes for nitrate

179. Wisconsin Department of Natural Resources NR 243 CAFOs, Water Permits and NR 243
Link: CAFOs, water permits and NR 243

180. Wisconsin Department of Revenue Case No: 16-76-01
Link: WI-DOR-Tax-Appeal-Findings-and-Order
Property taxes were lowered by 27% ($60,000) for a Green County, Wisconsin neighbor to a 2,400-head hog finisher (just under 1000 animal units). This is shown in the Findings of Fact and Order from Todd Knutson's property tax appeal in Green County, Oct 2016.

181. Wisconsin's Green Fire. High Capacity Well Impacts on Wisconsin Lakes, Streams, and Wetlands. June 3, 2020
Link: High Capacity Wells
Wells pump groundwater. In Wisconsin, groundwater is usually well-connected to local lakes, streams, and wetlands, so when groundwater is pumped from wells, water levels in aquifers (the geology that holds groundwater) drop, as do the levels of connected lakes and wetlands and the flows of connected streams. The effects of pumping on fish, wildlife, and public water rights are a matter of degree: a little pumping may have a barely perceptible impact, but larger amounts can be devastating. A high capacity well as defined in Wisconsin statutes is one with a "… capacity to withdraw more than 100,000 gallons [of groundwater] per day…" or that "… together with all

other wells on the same property, has a capacity of more than 100,000 gallons per day." Wisconsin has some 9500 wells capable of pumping more than 100,000 gallons per day, and only a handful were evaluated for their impacts on lakes, streams, and wetlands before receiving regulatory approval. High capacity well pumpage is typically about 250 billion gallons per year (reported for 2013, a fairly average weather year), with roughly 40% attributable each for agricultural irrigation and municipal use, and lesser amounts for industry, stock watering, mining, and others.

182. Wisconsin Legislative Audit Bureau. Wastewater Permitting and Enforcement, Report 16-6, June 2016.
Link: Wastewater Permitting and Enforcement DNR June 2016
The Wisconsin DNR struggles to keep up with the growth of CAFOs in Wisconsin from 135 in 2005 to 319 in 2020. For example, a 2016 study by the Legislative Audit Bureau of the WPDES program found that one-third of the CAFOs were operating under expired permits. In 2020, 91 (28%) CAFOs are operating under expired permits.

183. Wisconsin State Legislature. Chapter NR 151 Runoff Management
Link: Wisconsin Legislature: Chapter NR 151

184. Wisconsin Supreme Court Case No.: 2018AP59, July 8, 2021
Link: WI Supreme Court - Clean WI vs Wi DNR - High Capacity Wells
Court ruled that the DNR must exercise its authority to protect Wisconsin's water resources. Case looked at the impact of a controversial 2011 law known as Act 21 on the DNR's ability to use its permitting process to protect water resources. Centered around eight high-capacity well permits issued by the DNR in the Central Sands region of the state for large-scale agriculture irrigation. Clean Wisconsin and co-litigant Pleasant Lake Management District challenged those permits, pointing to DNR's own statements that the wells would harm nearby lakes and streams. The Wisconsin Legislature and industry groups intervened, arguing that Act 21 prevented the DNR from taking steps through its permitting process to keep groundwater and waterways from harm. DNR changed its position shortly after the election of Governor Tony Evers to support Clean Wisconsin's challenges.

185. Wisconsin Supreme Court Case No.: 2016AP1688, July 8, 2021
Link: WI Supreme Court - Clean WI & MEA vs Wi DNR & Kinnard - Groundwater Monitoring
Court ruled that the DNR must exercise its authority to protect Wisconsin's water resources. Case looked at the impact of a controversial 2011 law known as Act 21 on the DNR's ability to use its permitting process to protect water resources. Case involved a wastewater discharge permit issued by the DNR in 2012 for Kinnard Farms, a large dairy operation in Kewaunee County. Clean Wisconsin and co-litigant Midwest Environmental Advocates (MEA) argued the DNR should have required offsite groundwater monitoring and imposed an animal unit limit as conditions of its wastewater permit renewal to reduce the risk of manure contamination of nearby drinking water wells. The Wisconsin Legislature and Kinnard Farms dairy intervened, arguing that Act 21 prevented the DNR from taking steps through its permitting process to keep groundwater and waterways from harm. DNR changed its position shortly after the election of Governor Tony Evers to support Clean Wisconsin and MEA's challenges.

186. Wisconsin Supreme Court Case No.: 2016AP1688, July 8, 2021
Link: WI Supreme Court - Clean WI & MEA vs Wi DNR & Kinnard - Groundwater Monitoring

187. Wisconsin Towns Association. Comments on Wisconsin Livestock Facility Siting – Draft Rule ATCP 51. 2019 pages 1-8.
Link: DATCP Documents
The proposed rules bring consistency and clarity to the law and ensure that standards are based on current scientific research and findings. We applaud the Board for demonstrating a willingness to engage the public and for its efforts at serving the broad needs of all Wisconsinites.

Media Articles

188. Agweek TV. JBS Pork Plant Euthanizing Market Hogs. April 29, 2020
Link: AgweekTV: JBS Pork Plant Euthanizing Market Hogs - YouTube

189. Buntjer, Julie. JBS begins euthanizing hogs. *AgWeek* April 29, 2020
Link: JBS begins euthanizing hogs at Worthington plant | Agweek
The process of euthanizing market-weight hogs began Wednesday morning, April 29, at the JBS pork processing facility in Worthington, but at a far lower capacity than the 13,000 estimated to be handled by the plant.

190. Clemons, Michelle. About 4,000 swine killed in barn fire near Mondovi. *WEAU-13*. March 13, 2019
Link: About 4,000 swine killed in barn fire near Mondovi
On Wednesday, March 13, 2019 at about 5:40AM the Buffalo County Sheriff's Office received a report of a large hog barn on fire at Holden Farms, located at W20 Gonty Road in the Town of Naples, east of Mondovi.

191. Egan, Dan. Changes in America's dairy land foul the waters of Green Bay. *Milwaukee Journal Sentinel.* September 2, 2021
Link: Changes in America's Dairyland foul the waters of Green Bay (jsonline.com)

192. Kremer, R. DNR Investigating 'Large' Manure Spill at St. Croix CAFO, Spill Wasn't Reported Until 3 Months After Leak. *WPR.* Apr 13, 2017
Link: DNR Investigating 'Large' Manure Spill At St. Croix CAFO
The Department of Natural Resources says it's investigating a large manure spill in St. Croix County that happened in December but wasn't reported until March 29.

193. Moran, Tim. 12,000 Pigs Killed In Minnesota Barn Fire a 'Tragedy'. *Patch* May 20, 2021
Link: 12,000 Pigs Killed In Minnesota Barn Fire A 'Tragedy'
Trucks from nine fire departments responded to the Woodville Pork farm on 368th Avenue in Waseca Sunday night, taking several hours to fully put out the barn fire that killed the pigs, KEYC and others have reported. Waseca Fire Chief Jason Forshee told the news station about 9,000 piglets and about 3,000 sows died in the fire. The cause of the fire hadn't been determined by Thursday, and Marshall Radio said it could be several days before it's determined. Farming experts in the area have said the lack of rain, coupled with high winds, have caused other farm building fires, KEYC reported.

194. Narishkin, A, Cameron, S, Barranco, V. Why 1 million pigs could be euthanized due to COVID-19-related supply chain issues. *Business Insider.* June 25, 2020
Link: Why 1 Million Pigs May Be Euthanized

Beginning in April 2020, the US experienced a meat shortage and unprecedented meat prices. That's because COVID-19 outbreaks in at least 167 meat-processing plants forced almost 40 plants to close. In an already compact industry, any one plant closure strands millions of pigs at farms. Could this break in the supply chain been avoided? Agricultural economist Jayson Lusk says automation in meat-processing plants could be one solution. Another? Smaller, vertically integrated farms, like Belcampo Meat Co. in Northern California.

195. National Pork Producers Council. Statement on Implementation of Defense Production Act. April 29, 2020.
Link: NPPC Statement on Implementation of Defense Production Act
President Trump last night invoked the Defense Production Act (DPA) to extend much-needed federal support to the U.S. pork production system. By triggering the DPA, the federal government will prioritize the continuity of pork processing plant operations. Howard "A.V." Roth, NPPC president and a producer from Wauzeka, Wisconsin.

196. Neeley, Todd. Farms Exempt from Emissions Reporting. *Ohio Country Journal June 5, 2019*
Link: Farms Exempt From Emissions Reporting – Ohio Ag Net|
Farms are now exempt from reporting air emissions from animal waste after the EPA on Tuesday finalized a new rule amending the emergency release notification regulations under the Emergency Planning and Community Right-to-Know Act, or EPCRA.

197. Swine Cast, Persistent PRRS in Finishing Pigs Raises Concerns. September 3, 2021
Link: SwineCast 1168, Persistent PRRS in Finishing Pigs Raises Concerns
Various PRRS strains, including 144 lineage C, remain dangerously active in the Midwest pig production belt, despite a hot, dry summer. Three veterinarians describe what they are seeing and doing to reverse PRRS-driven losses. Dr. Deb Murray (New Fashion Pork), Dr. Kat Wood (Christensen Farms), and Dr. Ryan Strobel (Swine Vet Center), have a lively and timely discussion with the At the Meeting team (Dr. Montserrat Torremorell - College of Veterinary Medicine, University of Minnesota, Dr. Gordon Spronk - Pipestone Veterinary Services, and Dr. Tom Wetzell - Swine Veterinary Consultant).

198. Weingarten D, Davis T: A Minnesota mega-dairy is transforming Arizona's aquifer and farming lifestyles. *High Country News.* August 4, 2021
Link: A mega-dairy is transforming Arizona's aquifer and farming lifestyles (Sucked Dry) (hcn.org)
Minnesota's Riverview Dairy has deep pockets and long straws. Hundreds of people, mostly low- to middle-income, living in Arizona's high-desert landscape whose groundwater is rapidly disappearing as water is pumped to grow alfalfa, corn, nuts, wheat and barley. Kerkhoven, Minnesota, farmers Jim and LeeAnn VanDerPol have watched as their community lost many of its residents following decades of shrinking agricultural margins and increased corporate consolidation in the livestock sectors. Their former neighbors have been replaced by the five huge Riverview facilities within 10 miles of their house. In Chokio, Minnesota, about an hour away, locals successfully fought to keep Riverview from building a 9,200-cow dairy, citing concerns about pollution and groundwater decline.

199. Ziemba, L. Yakima Case a Bellwether of Future Challenges Ahead. June 15, 2015 *Hoards*
Link: Yakima case a bellwether of future challenges ahead (hoards.com)
For decades CAFOs thought the federal Resource Conservation and Recovery Act (RCRA), applied to garbage landfills. That changed in 2015, when a federal judge in Washington State ruled that RCRA did apply to CAFO waste as part of a lawsuit against the 7,000 head Cow Palace. Settlement required mitigation measures including manure storage liners, monitoring wells, compliance monitoring and a reduction in the use of manure as fertilizer.