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Oh Crap, Another Problem for Agriculture

I, like you I presume, need to eat. Sometimes I, maybe like you, eat too much. And finding food is relatively easy in our country. There are restaurants (fast food, slow food, cheap food, expensive food), grocery stores (old term…supermarkets), specialty stores (like a store that only sells herbs cultivated in an organic farm deep in the woods of Humboldt County), farmers markets (which always block the street you want to take) and more. The reason this country is blessed with an abundance of food is because our agricultural businesses are still surviving, although any farmer will tell you it's a chancy business with an ever increasing amount of regulatory requirements. A Federal Appeals court just added another layer of regulation which is detailed elsewhere in this newsletter.

In summary, the case is a blow to the livestock, dairy and poultry industries of the agricultural community. In *Waterkeeper Alliance v. Environmental Protection Agency* 853 F,3d 527 (2017) the U.S. Court of Appeals for the D.C. Circuit ruled that the EPA exemption to agriculture from providing notification of air releases of animal wastes was improper. In this case the issue involved only manure, which apparently is considered a combination of feces and urine (I didn't realize they were a combo, but I'm a city slicker). In 2006, the EPA granted the exemption based on their belief that the subject notifications are unnecessary because in most cases a federal response is impractical and unlikely.

In a very dense decision (meaning there was a lot of intertied thoughts, citations, footnotes etc.), the court stated that the exemption conflicted with the language of both the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Emergency Planning and Community Right-to-Know Act (EPCRA). The information from such notifications becomes part of the Toxic Release Inventory (TRI) under EPCRA. The TRI in turn is used by the EPA for the purpose of planning, research and investigation. It is also used by some that would curtail agriculture and make it more of a profit challenge than the day before. (Sorry if I am offending anyone, but I think that this is true).

So now that we know about the law, what's all the fuss?

Unfortunately, while the court seems to believe that gathering the needed data is easy (just go hang some device out over some cows and read the data), the farm trade literature points out that it isn't and will require sophisticated equipment and outside technical advice to assist in calculating the data, analyzing it for reporting, and developing the proper reports. Relying on other reports for some guidance is a useless gesture. Nor is calculating data that can be used as a surrogate a way to go. There is no consistency from farm to farm, animal to animal, season to season etc. simply because the number of

variables is staggering, i.e. what animals, what their age is, what feed is being used, temperature, humidity, type of confinement and manure handling. (There is a lot more but you get the picture).

The application of the issue before the court deals with Concentrated Animal Feeding Operations (CAFO). The EPA defines a CAFO as an animal feeding operation that (a) confines animals for more than 45 days during a growing season, (b) in an area that does not produce vegetation, and (c) meets certain size thresholds. A CAFO congregates animals, feed, manure and urine, dead animals, and production operations on a small land area.

Not to be content with one general description, the EPA has divided CAFOs into small, medium and large (Tall, grande and venti - just like a Starbucks). One size fits all apparently doesn't work. Here are some examples.

Animal	Large	Medium	Small
Cattle/calf pairs	1,000 or more	300-900	Less than 300
Swine (weighing over 55 pounds)	2,500 or more	750-2499	Less than 750
Swine (weighing less than 55 pounds	10,000 or more	3,000-9,999	Less than 3,000
Turkeys	55,000 or more	16,500-54,999	Less than 16,500
Laying hens or broilers (liquid manure handling systems)	30,000 or more	9,000 - 29,999	less than 9,000
Chickens other than laying hens (other than a liquid manure handling systems)	125,000 or more	37,500 - 124,999	less than 37,500
Laying hens (other than a liquid manure handling systems)	82,000 or more	25,000 - 81,999	less than 25,000

Each of these critters eat, digest and expel feces and urine. For the sake of discussion, let's just lump them together (yuck) and call them "expellants". What we need to understand is that while many of us know what it means to pick up after your dog, clean your cat's litter box or your falcon's cage, there aren't many of us that have tried to clean up after a 1,500 lb cow. Multiply those expellants by 55,000 cows and you have a very large load (pun?) of manure to deal with.

Each animal, of course, leaves a present of different dimensions.

Animal	Animal Weight	Pounds of Manure Per Day
Dairy Cow	1400	120
Beef Cow	1000	58
Pig	65	5.5
Sheep	100	4
Hen	4	0.26

Extrapolating these data points we find, as an example according to the EPA, a 2,000-cow dairy generates more than 240,000 pounds of manure daily or nearly 90 million pounds a year (That's a lot of bull____). The United States Department of Agriculture (USDA) estimates that the manure from 200 milking cows produces as much nitrogen as sewage from a community of 5,000 to 10,000 people. But on the average farm manure production can range between 2,800 tons and 1.6 million tons a year. Large farms can produce more waste than some U.S. cities—a feeding operation with 800,000 pigs could produce over 1.6 million tons of waste a year. (Hopefully no such place exists and 800,000 are just used as a comparison or otherwise the world would have way too much bacon…well, that's not a bad thing…bacon does make everything better…). That amount is one and a half times more than the annual sanitary waste produced by the city of Philadelphia, Pennsylvania (and that's a city that thrives on Philly Steak Sandwiches). Annually, it is estimated that livestock animals in the U.S. produce somewhere between 3 and 20 times more manure than people in the U.S. produce (I assume this calculation does not include politicians as people in the U.S.). Though sewage treatment plants are required for human waste, no such treatment facility exists for livestock waste.

The potential for emissions exists wherever manure is present including from confinement buildings, open lots, stockpiles, anaerobic lagoons, and land application from both wet and dry manure management systems. A confinement facility may be a totally enclosed structure with full-time mechanical ventilation, a partially enclosed structure with or without mechanical ventilation, an open paved lot, or an open unpaved lot. Those that are enclosed are limited by the animal in question. While you may be able to build structures to house all your turkeys or hens, a 2,000 cow dairy farm would need a lot of space to build such a facility and it would cost millions and frankly the stink would be awful unless it was hermetically sealed.

The key to all this is the appropriate manure management, and like everything else, there are a wide variety of system requirements and theories depending on the animal, type of manure etc. A quick search on the web shows hundreds of different products and theories about manure management, each claiming they are the most efficient. For example, when manure is handled as a solid, storage may be within the confinement facility or in stockpiles that may or may not be covered. For liquid or slurry manure (this is making me a bit queasy now) handling systems, manure may be stored in an integral tank, such as a

storage tank under the floor of a confinement building (you thought an MTBE leak would be bad), or flushed to an external facility such as a pond or an anaerobic lagoon (Not to be confused with the ol' swimming hole seen in Andy of Mayberry – oops, showing my age). Emissions from storage tanks and ponds will differ from anaerobic (meaning the absence of free –or even paid for – oxygen) lagoons, which are designed for manure stabilization (I don't want to think about unstable manure).

There is also land application, which is spreading the manure on crop land, as it is an organic matter that assists in the growth of various crops. Mankind has been doing this for centuries. However, no surprise, the method of applying manure can affect emissions. Emissions from manure applied to the soil surface and not immediately incorporated will be higher than with immediate incorporation by disking or plowing (So spread it and bury it quickly). Injection, which is possible with manures handled as liquids or slurries, also will reduce emissions. Conversely, the use of irrigation for the land application of liquid manure will increase emissions of gaseous pollutants due to the increased opportunity for volatilization (That just can't be a pretty sight). While manure is valuable to the farming industry, in quantities this large it becomes problematic. Many farms no longer grow their own feed, so they cannot use all the manure they produce as fertilizer. In areas where there is a cluster of farms/ranches there is likely more manure then needed for land application unless it is shipped elsewhere, which has its own environmental impacts (Greenhouse gases from vehicles and manure…a deadly combo if I ever heard of one, unless we can run the vehicles on the gasses emitted from its own cargo).

The EPA is concerned with off gassing from expellants because while an individual cow here or there, or small gaggle of turkeys running about are no big deal, when you ratchet the numbers up, that's a horse of a different color (By the way, some movie trivia: The Horse of a Different Col**o**r was a horse who drew the carriage in the opening Emerald City scenes of the 1939 MGM film *The Wizard of Oz*. The cabbie (Frank Morgan) drove the carriage drawn by it. It would periodically change colors, hence its name. For those of you that may be concerned, four separate horses were used to create the effect of an animal that changes color from moment to moment; the filmmakers found that multiple color changes on a single horse were too time-consuming. The American Society for the Prevention of Cruelty to Animals (ASPCA) refused to allow the horses to be dyed; instead, technicians tinted them with lemon, cherry, and grape flavored powdered gelatin to create a spectrum of white, yellow, red, and purple. They had to be prevented from licking the colored powder off themselves between takes.)

One of the gases of concern is ammonia, which is a by-product of the microbial decomposition of the organic nitrogen compounds in manure. Nitrogen occurs as both unabsorbed nutrients in animal feces and as either urea (mammals) or uric acid (poultry) in urine. Because ammonia is highly soluble in water, ammonia will accumulate in manures handled as liquids and semi-solids or slurries, but will volatize rapidly with drying from manures handled as solids. The concern about ammonia may be misplaced as it is found throughout the environment in air, water, soil, animals, and plants. It does not last very long in the environment and is rapidly taken up by plants, bacteria, and animals. Nor does it build up in the food chain, but rather it serves as a nutrient for plants and bacteria.

No health effects have been found in humans exposed to typical environmental concentrations of ammonia. Exposure to high levels of ammonia in air may be irritating to your skin, eyes, throat, and lungs and cause coughing and burns. Lung damage and death may occur after exposure to very high levels and Occupational Safety and Health Administration (OSHA) does have some standards, but out in the open there should be no problem. Obviously in an enclosed area care must be taken, as the buildup of the gas could be significant.

Another gas is hydrogen sulfide (It the colorless gas with the characteristic foul odor of rotten eggs.) formed by bacteria in the digestive track of the animal that decomposes materials that contain vegetable or animal proteins. In fact, cattle consume sulfur in their feed and drinking water, and absorb it into their bodies, primarily as sulfide. It is an essential nutrient for ruminants, but when sulfur is consumed in excess of dietary requirements, it is excreted.

It can corrode structural steel or concrete, (faster than a speeding bullet) causing fracture or failure. OSHA has set regulatory limits for occupational exposure. Hydrogen sulfide gas causes a wide range of health effects and at high levels can lead to death. It is heavier than air and can accumulate in manure pits, holding tanks and other low areas in a livestock facility. Also, it remains in the atmosphere for an average of 18 hours. During this time, it can change into sulfur dioxide and sulfuric acid aka acid rain (We haven't heard about acid rain in a bit, so this is a refreshing walk down memory lane).

Given its role in climate change methane generation is a significant problem and it accounts for 60% of the gas emitted from manure. Methane is a product of the microbial degradation of organic matter under anaerobic conditions. The microorganisms responsible, known collectively as methanogens, decompose the carbon (cellulose, sugars, proteins, fats) in manure and bedding materials into methane and carbon dioxide. Because anaerobic conditions are necessary, manures handled as a liquid or slurry will emit methane. Manures handled as solids generally have a low enough moisture content to allow adequate diffusion of atmospheric oxygen to preclude anaerobic activity or permit the subsequent oxidation of any methane generated. Methane is insoluble in water. Thus, methane volatilizes from solution as rapidly as it is generated (There has been some effort to harvest the methane for fuel at landfills and used for co-gen. Not sure how that is working out.).

Lastly, while not a gas, there is also the issue of particulate matter both PM10 and PM2.5 (Giving a whole new meaning to the terms "a cloud of dust"). The particulate is mainly comprised of organic material such as fecal matter, feed materials, pollen, bacteria, endotoxins, fungi and viruses (and their products), skin cells and the products of microbial action on feces and feed. Inorganic compounds include silicates, calcium carbonate, and free (crystalline) silica. Various health-related studies indicate significant health issues for farm workers stemming from particulate exposures.

So, now that you are armed with the information, what do we do now? Where do we draw the line, or do we not draw the line, or do we draw it and ignore it? For me, we can only do so much with the product of natural process of digestion and expulsion. And while reporting the emission levels and quantity from livestock and fowl has merit, what happens next? Are we going to ask all farmers/ranchers to hang bags on the back of their cattle/dairy cows to catch the manure so that, like a dog's waste bag, it can be twist tied and thrown away? Do we create massive manure management systems that are completely enclosed and can process the manure to release the gasses in a controlled manner, which of course would never pass any type of environmental challenge by no-growthers, environmental naysayers etc.? Do we invest in advanced air scrubbers that hang on each animal that catches the manure and removes the offending gases in situ? Do we have someone chase animals around the farm putting a device over the expellant with a suction tube leading to a portable purifier? Do we try to breed turkeys that do expel only daisies? Do we use genetic engineering so manure is gas free? What do we do, how do we do it, and what's it going to cost?

There is really no good answer. We have to accept the fact that unless we are all going the tofu route (and even with that there has to be something environmentally wrong with that), there are going to be gas emission from animals. We need to find good practices that do not cripple the farming community. I think we will see that these reports will only make matters worse for farmers fairly soon. Expect to see NGO suits once the data is in. I think as a country we should recognize the need for food and an abundance of it. If I were to balance all this out, I think I would stand with the farmers on this one.