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From field to shore: Policy improvements to better protect ecosystem and human health from poultry wastes in Virginia

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Abstract: Commercial poultry production is a large industry with economic importance in Virginia. However, mismanagement of manures and wastes generated from the poultry industry can be a serious threat to ecosystem and human health. Primarily, there is a concern about nutrient pollution related to runoff and infiltration of poultry wastes. High nutrient loading can cause groundwater contamination, eutrophication, and harmful algal blooms (HABs). Additional concerns include metals, antibiotics, and pesticides that can be found in poultry wastes. To determine existing threats to ecosystem and human health from the poultry industry, Virginia policies regulating the industry are reviewed and their strengths and weaknesses are identified. These policies are compared to Maryland state policies to further determine strengths and weaknesses. Potential policy recommendations to improve regulation are offered to a stakeholder panel and final recommendations are provided at the end of this document. Recommendations include improved nutrient tracking, improved litter transportation tracking, offering safe transportation guidelines, improved application guidelines, and standardized nutrient testing.

Introduction

Poultry agriculture is a large industry in Virginia (VA), bringing in over $13 billion annually (*Virginia Poultry Federation*, n.d.). The industry provides many blue-collar jobs to VA workers and produces large quantities of poultry meat and eggs, mainly from chickens. However, along with the economic benefits of poultry come potential environmental drawbacks. The poultry industry causes a significant amount of nutrient pollution regionally and globally (Gerber et al., 2008). The poultry industry in VA is no exception, with production on the Eastern Shore being of particular concern. Although poultry is also produced in the Shenandoah Valley in VA, the Eastern Shore offers a very compact environment for poultry production where impacts on aquatic health are often heightened. The Eastern Shore is a narrow peninsula about 18 miles by bridge-tunnel from Tidewater VA, meaning that pollution generated in the region is in close proximity to aquatic resources. Therefore, poultry production on the VA Eastern Shore is of particular concern for water quality in the Chesapeake Bay

On the Eastern Shore, poultry production is concentrated in Accomack County. As of 2019, there were 480 chicken houses on 83 Concentrated Animal Feeding Operations (CAFOs) with another 19 permitted but not yet built (*Poultry and Manure Production on Virginia's Eastern Shore*, 2020). Based on the records of 70 out of these 83 CAFOs the Eastern Shore has the capacity to produce more than 85 million chickens annually, which is expected to produce about 137,000 tons of manure (*Poultry and Manure Production on Virginia's Eastern Shore*, 2020). For context, that amount is equal to the weight of about 1,225 blue whales, the largest mammal on earth. According to a report by the nonpartisan nonprofit organization The Environmental Integrity Project, 74% of CAFOs had problems complying with nutrient management regulations during the period May 2017-April 2019 (*Poultry and Manure Production on Virginia's Eastern Shore*, 2020). Problems can take the form of outdated or missing paperwork; residual manure around poultry houses, storage areas, or on manure pads; improperly managed dead birds; etc. (*Poultry and Manure Production on Virginia's Eastern Shore*, 2020). In addition to nutrients, contaminants of concern from improper waste management on poultry farms include antibiotics and heavy metals, which are added to feeds as growth promoters (Gerber et al., 2008). Non-compliance, therefore, presents a threat to aquatic resources.

This document is divided into two parts; part I addresses the scientific background necessary to understand poultry industry pollution issues related to aquatic ecosystems and human health; and part II reviews existing VA state policies with the goal of improving responses to poultry industry pollution. The scientific background section discusses concerns with poultry industry waste; the impacts of excess nutrients on waterways and human health; antibiotic use and heavy metal feed additives; and other chemical contaminants from poultry farming. The policy review section looks at VA state policies on CAFO permitting, wastewater discharge, manure application, poultry wastewater biosolids, groundwater management, and manure transportation as well as Maryland (MD) policies that have recently been updated to address increasing poultry pollution issues. The policy recommendations presented at the end of part II are created using the best available science as presented in part I.

Part I: Scientific Background

Main Issue: Nutrients

Poultry manure contains high levels of nitrogen (N) and phosphorous (P) (Gerber et al., 2008), which can negatively impact aquatic ecosystem and natural resources. There are two main pathways by which manure enters the aquatic environment: direct discharges from poultry CAFOs, and runoff of manure intentionally applied as organic fertilizer to agricultural fields. While some nutrients may be incorporated by microorganisms during the composting process, both pathways may contribute significant quantities of N and P to the aquatic environment. Nutrients are more likely to run off of agricultural fields when manure has been overapplied; there is evidence that P levels are elevated in soils on the Eastern Shore following years of manure overapplication (*Poultry and Manure Production on Virginia's Eastern Shore*, 2020). While P is an essential nutrient, plant P requirements are much lower on a gram basis than demands for N. This means that nutrients are left in the soil rather than being taken up by plants when nutrients are applied in concentrations beyond agronomic needs. Additionally, poultry carcasses contain high N and P levels and therefore wastewater effluent from processing plants, and especially improper disposal of carcasses, can result in excess nutrient loading in aquatic ecosystems (Gerber et al., 2008). Aquatic nutrient contamination concerns include eutrophication and harmful algal blooms (HABs).

There is extensive data on the relationship between nutrient pollution and eutrophication of freshwater and marine waterways. For example, the eutrophication of Tenkiller Reservoir in Oklahoma was directly linked to nutrient loading to the waterbody. That loading was associated with the growth of the animal agriculture industry and particularly with the establishment of local poultry CAFOs (Cooke et al., 2011). Specifically, the rapid change in the state of Tenkiller Reservoir from oligotrophic to eutrophic coincided with expansion of the poultry industry and the disposal of untreated litter on agricultural fields surrounding the water body (Cooke et al., 2011). Poultry litter accounted for 71% of the P in the reservoir, and the movement of P was controlled by rainfall (Cooke et al., 2011). Rainfall can leach nutrients from the soil, as well as generate surface runoff of recently applied manure or manure sitting on poultry farms. Across the U.S., net soil accumulation of P has been estimated at 22 kg P/ha/yr, representing a huge reservoir for nutrient runoff to waterways (Cooke et al., 2011).

A less studied topic is the relationship between poultry CAFO nutrient contamination and the occurrence of HABs. However, recent research on this topic has revealed that changes in the supply of nutrients, as are often associated with agricultural nutrient pollution, can create favorable HAB conditions (Glibert & Burford, 2017). According to Glibert & Burford (2017), many HABs appear capable of exploiting scenarios where nutrients are not in Redfield proportions. This does not mean that all HABs are related to excess nutrients, but this relationship is now well-established (Glibert & Burford, 2017). Specific nutrient imbalances may be favorable to specific HAB species. Many cyanobacteria and marine dinoflagellate HABs are more toxic when N is in excess over P, but there are examples of HAB species that become more toxic under excess P conditions (Glibert & Burford, 2017). The presence of more toxic HABs means more toxins being released (Glibert & Burford, 2017).

Aside from surface water contamination, N and P can also enter groundwater systems. Agriculture is considered one of the main polluters of shallow groundwater aquifers like that found on the Eastern Shore (*Virginia Eastern Shore Groundwater Resources*, n.d.; Zhang et al., 2018). The Eastern Shore has both confined and unconfined aquifers, with the unconfined (or surficial) aquifer existing close to the surface (*Virginia Eastern Shore Groundwater Resources*, n.d.). The rate of N and P leaching into groundwater from surrounding soil is dependent on the soil type (Rao, 2006). Clay-rich soils appear to leach less NO_3^- to groundwater, indicating that the cation and anion exchange capacity and the low permeability of the soil are involved in nutrient leaching rates (Chandel & Kumar, 2016; Rao, 2006). In comparison, sandy soils readily leach N and P to groundwater (Majumdar, 2003). Eastern Shore soil is mostly loamy (*National Cooperative Soil Survey (NCSS) Soil Characterization*, n.d.), which has an intermediate potential to leach N and P. Soil N and P contamination is often associated with poultry farms, as well as agricultural fields where poultry waste is spread as fertilizer (Majumdar, 2003; Rao, 2006). Importantly, contaminated groundwater can also discharge into surface waters (J. Wu et al., 2021).

The aquatic health impacts of eutrophication are well understood. High levels of nutrients can stimulate algal blooms (Anderson et al., 2002). After the algae take up the excess nutrients in the system, they die and are decomposed by resident organisms (*Virginia Eastern Shore Groundwater Resources*, n.d.). The act of decomposition consumes large amounts of oxygen, creating anoxic zones that kill vulnerable species, especially sessile organisms (*Virginia Eastern Shore Groundwater Resources*, n.d.). If harmful algal growth is stimulated, the toxins released can kill aquatic organisms, in addition to creating anoxic problems once the bloom dies (*Virginia Eastern Shore Groundwater Resources*, n.d.). Some toxins may become airborne or impact drinking water (Calusa Waterkeeper, 2022; US EPA, n.d.)**.** Toxins that accumulate in seafood products that humans consume, especially shellfish (Anderson et al., 2002), may also affect human health. This may lead to shellfish harvesting closures, which can indirectly impact human health if there is subsistence use of shellfish in the region, as well as financial hardships. There is potential for this to occur with private shellfish leases on the Eastern Shore. Eutrophication in general can affect human health by eliminating edible aquatic species on which local residents rely for food. Further, nutrient contamination of groundwater can impact human health indirectly as groundwater flows into surface waters and directly if groundwater is used as a drinking source. High levels of nitrate (NO_3^-) may cause methemoglobinemia, or blue baby syndrome (Majumdar, 2003). The reduction of nitrate in the intestine leads to nitrite (NO_2^-) reacting with blood hemoglobin to form methemoglobin, which binds oxygen less efficiently (Majumdar, 2003). While this condition can affect any individual, babies are particularly susceptible because they have less hemoglobin available to transport oxygen (Majumdar, 2003). Additionally, this condition can be accentuated by toxic substances that oxidize hemoglobin or facilitate its oxidation (Majumdar, 2003).

<u>Antibiotics</u>

In the 1940s, antibiotics were discovered to be effective growth promoters in poultry due to interactions with the intestinal microbial population (Guetiya Wadoum et al., 2016). This application of antibiotics expanded poultry sector productivity by enhancing growth rates and thereby getting poultry to market faster (Guetiya Wadoum et al., 2016). It is estimated that 80% of food-producing animals now receive antibiotics for part or all their lives (Guetiya Wadoum et al., 2016). This means that about 52% of the approximately 34.3 million lbs of antibiotics sold or distributed in the US annually are being used on livestock, or about 10.5 million lbs of antibiotics per year *just in the US* (Davis et al., 2018; Kim & Carlson, 2007).

Antibiotic use continues to increase globally despite various companies claiming shifts to antibiotic-free meat production (Davis et al., 2018).

The two main pathways by which antibiotics from poultry enter waterways are via direct manure runoff or via runoff from field application of manure (Kim & Carlson, 2007). Up to 90% of applied antibiotics may be excreted in manure due to overapplication (Kim & Carlson, 2007; Sarker et al., n.d.). While human waste, other animal agriculture, and aquaculture all contribute antibiotics to the aquatic environment (Kim & Carlson, 2007), the contribution from poultry can be substantial, especially in areas with CAFOs (van den Bogaard et al., 2001). This is especially true given that some antibiotic use is still allowed under labels like "raised without antibiotics" and "organic," including the injection of antibiotics into chicken eggs to promote faster embryo development (Davis et al., 2018). Antibiotic usage is typically different between humans and livestock animals and even between livestock species (Kim & Carlson, 2007); thus, antibiotics used in poultry CAFOs can be traced. Unfortunately, very little is known about the behavior of antibiotics in the aquatic environment or soils; only a handful have known partitioning coefficients (Liang et al., 2013), and individual antibiotics are difficult to identify in field studies, likely because families of antibiotics have very similar chemical structures. Despite the paucity of research, some antibiotics have been identified in sediment, surface water, groundwater, and even drinking water (Liang et al., 2013). Transport into these aquatic resources occurs via the pathways described above; entry into groundwater occurs via seepage through soils when manure is applied to agricultural fields or left in piles on poultry farms. Notably, some antibiotics can be destroyed by select composting processes (Sarker et al., n.d.), but those treatments are not widely applied.

Antibiotics in the environment stimulate the spread of antibiotic-resistant bacteria (ARB) and antibiotic-resistant genes (ARG) (Kim & Carlson, 2007; Liang et al., 2013; Sarker et al., n.d.; Troell et al., 2019). van de Bogaard et al. (2011) state that "antibiotic usage is considered the most important factor promoting the emergence, selection, and dissemination of ARBs in both veterinary and human medicine." Bacterial ARGs develop in response to chronic, sublethal exposure to antibiotics. Natural selection encourages propagation of those bacteria that are resistant to antibiotics found in the environment (and therefore survive), passing ARG through generations of bacteria, and horizontally between microbial species, until they become the dominant allele(s). Humans may be at risk if they become infected with pathogenic ARBs, as antibiotics may be ineffective. Exposure to ARBs can occur through consuming contaminated water (Liang et al., 2013), aquatic foods, or through contact with surface water during recreational activities. ARGs have also been demonstrated to transmit horizontally from poultry to poultry farmers and slaughterers (van den Bogaard et al., 2001).

<u>Metals:</u>

Similarly to antibiotics, select inorganic metals are added to chicken feeds to promote growth (Gerber et al., 2008). Common metals include arsenic, copper, and zinc, which may additionally be used in medicines (Gerber et al., 2008) and may be added in forms like zinc oxides, zinc sulfates, copper sulfates, etc. (according to a review of some commercial chicken feeds). While many metals are considered micronutrients and thereby required by chicken and human bodies in small quantities, they are often overapplied in feeds. This leads to excretion in urine and feces when metal ions are not absorbed by the body. For example, copper can be added to chicken feeds in concentrations as high as 83 mg/kg and zinc as high as 306 mg/kg (National Research Council, 1994). By comparison, the recommended dose in adult males 19 years or older is approximately 11 mg of zinc per day (Dorval Pine & Beach, 2022), or about 0.12 mg/kg assuming an average weight of 90 kg. If poultry have similar nutrient requirements to humans, added concentrations of such metals are too high for complete dietary absorption. Therefore, these metals are released from poultry farms in manure and may enter aquatic systems through on-site manure and/or off-site fertilizer runoff.

Aquatic organisms also require certain metals in small quantities as micronutrients. However, such metals become toxic if organisms are constantly exposed to excessive concentrations in the water or the sediments for benthic organisms. In fact, heavy metal toxicity is such an issue in the aquatic environment that U.S. states routinely issue fish consumption advisories around fish tissue contaminated with heavy metals. The state of VA issues such advisories only for mercury in fish tissue (*Fish Consumption Advisories*, n.d.), but other states monitor for arsenic, cadmium, lead, and/or selenium and issue fish consumption advisories when such metal levels are elevated (King et al., 2021). Therefore, not only can these metals be toxic to aquatic organisms, but also to human consumers. Toxicity endpoints include neurological disorders, reproductive toxicity, developmental disorders, carcinogenicity, and organ effects (US EPA, 2000).

Of note here is how and why poultry themselves do not develop heavy metal poisoning when consuming these feeds. Although select metals are fed to poultry in potentially toxic concentrations, poultry do have some ability to clear metals from their systems, explaining why these end up in manures in the first place. This luxury is not afforded to aquatic organisms that are constantly exposed to metals in the water column and/or the sediments. Additionally, metals that do accumulate in the body due to chronic exposure require time to cause obvious health issues. Most commercial poultry animals do not live long enough (usually about 6-10 weeks) to present chronic heavy metal poisoning symptoms. Furthermore, as with antibiotics, poultry production is not the only source of metals to the environment and may not constitute a large source in local areas depending on the industries present. Other sources of metals to the environment include human wastewater, industrial operations, vehicular traffic runoff and e-waste recycling.

<u>Other Contaminants of Concern:</u>

Pesticides are another category of contaminants of concern. Insecticide, fungicide, and herbicide residues from feed crops may be transferred to and accumulate in livestock (Oruc, n.d.; H. Wu et al., 2022). This is particularly true when animal feeds incorporate remnants of dead animals, such as the incorporation of poultry feathers in poultry feeds (H. Wu et al., 2022). Additionally, some pesticides are used directly on poultry to kill parasites or on farms to eliminate pests like mosquitos and flies (that are often attracted to the feces and standing water on poultry farms) (H. Wu et al., 2022). Similarly, fungicides may be applied to animal feeds to prevent mold or mildew in storage and are sometimes used directly on poultry to treat conditions like foot rot disease and repel parasites (Oruc, n.d.). Fungicides may even be dosed internally to eliminate intestinal parasites (Oruc, n.d.). Not only have these pesticides killed livestock in the past, but many are also toxic to aquatic organisms (Oruc, n.d.). Therefore, as these chemicals enter waterways, they have the potential to harm aquatic organisms, potentially altering ecosystems in the process. Furthermore, many of these compounds are toxic to humans and can cause health issues when consuming contaminated water or aquatic foods (Oruc, n.d.). Health endpoints include reproductive toxicity, teratogenic impacts, carcinogenicity, mutagenicity, and various organ toxicity (Oruc, n.d.). While contributions of pesticides, herbicides, and fungicides to the aquatic environment are typically low from poultry pollution, these contaminants are of note as some can interact with other contaminants released from poultry farms.

Part II: Policy Review

Introduction:

Virginia has many policies that regulate the poultry industry and its associated pollution, including permitting processes, nutrient management plans (NMPs), water quality protections, litter application requirements, and a litter transport system. A review of current policies and their strengths and weaknesses is prudent before attempting to suggest new policies to improve regulation. The following sections review the most relevant pieces of VA policy for the protection of aquatic resources from poultry pollution. These policies are then compared to pertinent policies in Maryland (MD). Next, recommendations are made to improve VA policies related to poultry agriculture. These recommendations are based on the best available science, as outlined in Part I.

CAFO Permitting:

According to the Virginia Administrative Code section, CAFOs are considered pollution point sources that require Virginia Pollutant Discharge Elimination System (VPDES) permits for discharges to water bodies (9VAC25-31-130). All medium and large CAFOs require permits (9VAC25-31-130); a medium chicken CAFO is defined as an animal feeding operation (AFO) that stables or confines 16,500-29,999 laying hens or broilers if the AFO uses a liquid manure handling system, and 37,500-124,999 chickens (other than laying hens) if the AFO uses another form of manure handling (9VAC25-31-10). A large chicken CAFO is defined as an AFO that stables or confines at least 30,000 laying hens or broilers if the AFO uses a liquid manure handling system, and at least 125,000 chickens (other than laying hens) if the AFO uses another manure handling technique (9VAC25-31-10). Potential discharges that require a VPDES permit under this policy include manure, litter, and process wastewater (hereby referred to as litter) generated directly by animals or by the production of those animals (9VAC25-31-130), meaning their feeding, bathing, watering, etc. CAFOs smaller than the medium CAFO criteria do not require permits.

Strengths:

In addition to those AFOs considered medium and large CAFOs requiring VPDES permits for discharges, an AFO may need a VPDES permit if the operation is determined to be “a significant contributor of pollution to surface waters” (9VAC25-31-130). To determine if an AFO is contributing to such pollution, an on-site inspection is required and should consider the amount of waste reaching surface waters, the size of the operation, the location of relative surface waters, the means of conveyance of pollution to surface waters, the slope of the area, the local vegetation and rainfall, etc. (9VAC25-31-130). This means that, if relevant parties (namely Virginia Department of Environmental Quality, or VADEQ) are concerned that an AFO is producing waste that may be impacting the aquatic environment, they can inspect that AFO to establish if a VPDES permit is required. While the VPDES permit may ultimately allow the same volume of discharge to occur, that discharge will then be documented publicly so scientists can track the impacts of that discharge and citizens are aware of pollution that may affect them.

Additionally, as part of obtaining a CAFO permit, submission of an NMP is required (9VAC25-31-130). These NMPs are designed to help ensure the appropriate utilization of nutrients from litter produced by CAFOs. For more detailed information on NMPs, see the "Nutrient Management Plans" section below. Having a good NMP should decrease nutrient runoff and infiltration that can harm aquatic resources. Finally, there are public comment periods for permit applications and modifications for CAFOs (9VAC25-31-130). This alerts the public that a new CAFO is being proposed and allows them to voice their thoughts and opinions about that new (or modified) CAFO. All public comments must be considered by the permitting agency; "legitimate" means that there is substance to the comment besides an emotional opinion or simply a statement of approval or disapproval.

Weaknesses:

While a VPDES permit is required for most CAFO discharges to surface waters, there is an exemption for agricultural stormwater discharges (9VAC25-31-130). Agricultural stormwater discharge is defined as litter applied to land in accordance with a nutrient management program that discharges to surface waters due to a precipitation event (9VAC25-31-130). While it appears rare on the Eastern Shore for litter to be applied on CAFO lands, it is **extremely** common for that litter to be applied on other agricultural lands. If no precipitation-related discharges need to be covered by VPDES permits, then we do not know how much discharge is truly occurring to local water bodies. This is particularly true because VA receives a large volume of rain and/or snow every year. This problem will be explored further in the "Raw Litter Application Requirements" section.

An additional concern with CAFO permitting policy as it is written is that "two or more animal feeding operations under common ownership are considered… to be a single animal feeding operation if they adjoin each other or if they use a common area or system for the disposal of wastes" (9VAC25-31-130). This means that poultry companies can build CAFOs next to each other, use common areas for supplies and/or waste disposal, and only apply for one VPDES permit. While that permit still requires that all discharges be recorded from both CAFOs, allowing multiple CAFOs to be considered under one permit gives a false representation of the number of point pollution sources that exist on the Eastern Shore. Additionally, if the CAFOs have different forms of discharge or discharge to very different water bodies, combining them under one VPDES permit does not allow the permit to be as specific to each CAFO situation. This potentially allows avenues for CAFOs to discharge more than what would otherwise be allowed.

The following section will expand on the requirements of VPDES permits issued in the CAFO permitting process.

Wastewater Discharge Permits:

As mentioned above, VPDES wastewater discharge permits are required for both CAFOs and processing plants (slaughterhouses). Under current VA policies, wastewater discharge sources are categorized based on the type and volume of their discharges (VADEQ, n.d.-a). Major sources are those producing more than one million gallons of discharge per day, or industrial discharges requiring EPA review (VADEQ, n.d.). Minor sources are typically commercial and small industrial sources that produce less than one million gallons of discharge per day (VADEQ, n.d.). Most CAFOs produce only small volumes of low-potency pollutants and are categorized as general sources (VADEQ, n.d.). Discharge permits are issued as general permits for those sources considered general or as individual permits for major and minor sources (VADEQ, n.d.). Processing plants usually have individual permits that require site-specific regulations. Since CAFOs fall under general sources, they are issued general permits. Requirements of the general permit for CAFOs include groundwater monitoring for ammonium and nitrate for earthen liquid waste storage facilities that sit below mean high water; soil testing for phosphorous, potash, calcium, and magnesium where litter is land applied; litter testing for total nitrogen, ammonium, phosphorous, potassium, and moisture; litter storage facilities designed to limit point source discharges to surface waters; no storage facilities or growing houses on floodplains; liners for earthen liquid waste; minimizing leachate and runoff after removing litter from storage; storing poultry litter to prevent contact with surface and groundwater; covering dry litter stockpiled for more than 14 days; visual inspections of stormwater diversion devices; storing litter with buffer zones to surface water; etc. (9VAC25-191-50). General permits do not cover poultry operations that use disposal pits for daily mortalities – these facilities must apply for an individual permit (9VAC25-191-50).

Strengths:

This is one of the few policies in VA that requires CAFOs to monitor groundwater, even if the monitoring requirement is limited to CAFOs with earthen liquid waste storage facilities below mean high water (9VAC25-191-50). This helps maintain existing quality of groundwater and protection of human health from complications of nitrogen in drinking water. Additionally, requiring that any litter stored for more than 14 days be covered is a sensible way to reduce runoff to surface waters without placing a large burden on CAFO operators. More generally, there is a Virginia Department of Conservation and Recreation (VADCR) VPDES permit training requirement (9VAC25-191-50). While no specifics of this training program are provided, the existence of the program is a positive element. Finally, NMPs are enforceable through this permit. To hold a general permit, any NMP developed after 2005 must have been developed with a certified planner (9VAC25-191-50). See the “Nutrient Management Plans” section below for more details.

Weaknesses:

The way this policy is currently written general permit holders are assumed to have no discharge to surface waters. The policy states that sources with “no point discharge of manure, litter, or process wastewater” qualify for the general permit, with an exception for discharges during storm events (9VAC25-191-50). Based on limited field studies and available knowledge from the Eastern Shore, this appears to be a poor assumption. More studies are needed to identify true discharge volumes from poultry CAFOs. Additionally, under the general permit, there are no requirements for testing nitrogen in soils where litter has been land applied (9VAC25-191-50). Without this monitoring, nitrogen levels may build up in soils, leading to increased leaching to groundwater and runoff to surface water. Additionally, while this policy requires groundwater, soil, and litter testing, there are no specifics provided on how this monitoring must take place. This means methodology is likely inconsistent between farms and therefore some monitoring results may be more accurate than others.

On the individual permitting side, there appear to be loopholes. For example, the Tyson Temperanceville processing plant holds individual permits for separate buildings on the same campus, creating a loophole where the cumulative impact of their full campus is not placed on a single permit. Sometimes, permits are held under different company names, such as subsidiaries that appear to be different facilities but are part of the same processing plant. If the cumulative discharges from a processing plant are split between permits, those permits may not protect nearby aquatic resources. Finally, for all permits, the policy states that flooding discharges must be reported and mitigated even though they are not regulated (9VAC25-31-190). However, there are no details on how these discharges need to be reported nor how to mitigate them. Some mitigation options are provided under the Virginia Stormwater Management Program (9VAC25-870-65), but that program is voluntary. Additionally, any permit can be transferred with a thirty-day advance notification (9VAC25-31-380), which may not be long enough for inspectors to ensure the transferee is similar enough to the transferring source to be considered under the same permit.

<u>Nutrient Management Plans (NMPs):</u>

Under Virginia Administrative Code Chapter 31, all CAFO permits must include an NMP (9VAC25-31-200). This must outline how: litter will be stored; storage areas will be maintained; mortalities will be managed; clean water will be diverted away from the operation; direct contact of animals with surface waters will be avoided; other chemicals produced by the operation will be handled; runoff will be prevented with conservation practices; testing protocols will be used to ensure compliance with the plan; proper documentation of the plan will be ensured (9VAC25-31-200). Relevant documentation, including nutrient testing results and the NMP itself, must be kept on-site at the CAFO for at least five years and be provided to any pertinent regulator who requests it (9VAC25-31-200). In addition to submitting the NMP with the CAFO permit application, every CAFO must submit an annual report detailing nutrients produced and used at the operation in the past year. The report must include: how many animals were produced; if they were in open confinement or under a roof; an estimate of the total volume of litter produced; any litter land application areas; the acreage used for any application; all discharges of litter (aside from agricultural stormwater discharges); if the NMP was developed by a certified nutrient management planner; any crops grown and the yield; the tested nutrient content of litter; the tested nutrient content of any applied soil; and any fertilizer use in any application areas (9VAC25-31-200).

In addition to CAFOs, individuals land-applying litter **may** submit an NMP (VADEQ, n.d.-b). The plan must include much of the same information as that for a CAFO (4VAC50-85-130); the only notable differences are that CAFOs must submit any planned crop rotations, projected land application of litter, projected amount of nitrogen available to plants, considerations for phosphorous accumulation, other potential nutrient sources, and the method of application if they are land-applying litter (9VAC25-31-200). A CAFO **does not** need to be land-applying to require an NMP; all CAFOs require an NMP to be submitted with their permit application. For more information on NMPs for land-appliers, see the "Raw Litter Application Requirements" section below.

Strengths:

Requiring NMPs for CAFOs is a good way for the state to track poultry litter on the Eastern Shore. Additionally, CAFOs must provide any recipients a nutrient analysis of that litter (9VAC25-31-200). This helps ensure that nutrients are not over-applied to land areas; and allow the litter recipient to calculate how much to apply to their land based on its agronomic needs. This means less runoff and groundwater infiltration and thus better protection of aquatic health on the Shore. DEQ has a fact sheet for land application of litter to assist end-users (VADEQ, n.d.) – as described in the "Raw Litter Application Requirements" section.

Weaknesses:

While NMPs do require testing of litter and soil where litter has been land-applied, there are no specifics in the policy as to the process. While some information is provided in separate resources for nutrient planners (VADCR, n.d.-a), nothing in the policy requires use of a particular methodology. This means that testing may be inconsistent between farms and some monitoring results more accurate than others. Additionally, NMPs do not require protection of groundwater resources. All focus is on discharges to surface waters, and agricultural stormwater discharges are still allowed under/not regulated by NMPs. Nutrient pollution of groundwater can create human health concerns and lead to further pollution of surface waters, as discussed in Part I. Without regulation of this nutrient pollution, aquatic resources are at risk. Importantly, NMPs are **not publicly available**. Only NMPs associated with CAFO permits can be FOIAed and obtaining information under FOIA is a very slow process. This is because NMPs are considered proprietary business information, thus the public cannot learn how local farms are addressing their nutrient-rich litter.

<u>Groundwater Protections:</u>

The Eastern Shore of VA is considered a groundwater management area (9VAC25-600-20). These are defined as areas where groundwater levels are declining or expected to decline, where two or more wells are interfering with each other, where the available groundwater supply has been or is currently overdrawn, or where groundwater has been or may become polluted (9VAC25-600-10). To obtain and maintain a groundwater withdrawal permit in a groundwater management area, the applicant must have a water conservation and management plan, detail use of water-saving equipment, maintain a loss reduction program (leak detection), provide water education to any employees that will be operating groundwater equipment, evaluate water reuse options, and comply with mandatory water use reductions during shortage emergencies (VA Groundwater Management Act, §62.1-254:62.1-270). Furthermore, to establish an agricultural withdrawal permit, the applicant must specify what kind of animals are being raised, the rate of animal weight gain, the presence of pregnant animals, the type of diet fed to animals, the level of dry matter intake, the level of activity of the animals, the quality of water used for the animals, and the ambient air temperature (VA Groundwater Management Act, §62.1-254:62.1-270).

Strengths:

The additional requirements for agricultural groundwater permit holders help ensure groundwater is used as responsibly as possible. For example, if a farm proposes use of potable water to mist animals, the permit may be denied, and a request can be made for the farm to use lower-quality water for such activities. In fact, agricultural permit holders must propose alternatives to groundwater use and employ the lowest quality of water feasible for each livestock activity (9VAC25-610-102). Public concerns over an application can also be addressed via comment periods for permit applications (9VAC25-610-250). Permits can be revoked or modified if permit holders are found to be withdrawing above their allocation (9VAC25-610-290), a process that has occurred previously on the Eastern Shore. Finally, the Groundwater Conservation Board has the authority to inspect any wells and springs for which a groundwater permit exists (9VAC25-610-130).

Weaknesses:

Unpermitted groundwater withdrawals are an ongoing issue on the Eastern Shore, particularly by poultry houses (Vaughn, 2018). It is not immediately clear how poultry operations may be exploiting this loophole as policy is currently written and remains an item of concern for the Eastern Shore. Therefore, groundwater permitting policy may need revisions to eliminate loopholes allowing unpermitted withdrawals.

<u>Stormwater Regulations:</u>

Since stormwater runoff is not regulated under VPDES permits, the Virginia Stormwater Management Program helps mitigate runoff concerns (9VAC25-870). The Virginia Runoff Reduction Method under this program lists best management practices (BMPs) that individuals can use to reduce stormwater runoff (9VAC25-870-65). BMPs include vegetated roofs, rainwater harvesting, soil amendments to reduce erosion, permeable pavement, grass channels, bioretention areas, allowing infiltration, dry swales, wet swales, extended detention ponds, constructed wetlands, etc. (9VAC25-870-65). Additionally, landowners can ask for approval of alternative practices that reduce stormwater runoff (9VAC25-870-65). These BMPs mainly seek to remove nutrients and sediments from stormwater runoff (9VAC25-870-65).

Strengths:

Listing specific BMPs and allowing landowners to seek approval of alternatives is a great balance. This flexibility encourages landowners to participate in the voluntary runoff reduction program.

Weaknesses:

The main concern with the Virginia Stormwater Management Program is that it is voluntary. It is unclear if this program is currently incentivized, so its impact in reducing nutrient loads to waterways may be modest. Additionally, while the Virginia Stormwater Management Act offers some regulation of stormwater discharges, livestock feedlots are **exempt** from all requirements of the act (VA Stormwater Management Act, §62.1-44.15:24-62.1-44.15:34). Therefore, agricultural stormwater discharges remain **unregulated** in VA.

<u>Raw Litter Application Regulations:</u>

There are four potential land application processes for poultry litter: (1) application rate based on an NMP, (2) standard application rate, (3) soil test-based application rate, or (4) application for phosphorous crop removal (VADEQ, n.d.). The standard application rate is 1.5 tons/acre once every three years (VADEQ, n.d.). If litter is being applied based on soil testing, soil samples must be taken at a minimum once every three years (VADEQ, n.d.). Litter cannot be applied year-round and application timing depends on whether the applier has an NMP. An NMP can lay out particular application timing for review and approval, but without an NMP, litter can only be applied to corn from March to June, to small grain plants from February to April, to cool weather hay or pasture from February to October, and for hot weather hay and pasture from April to August (VADEQ, n.d.). In addition, regardless of an NMP, no litter can be applied more than 30 days before planting or to frozen ground (VADEQ, n.d.). Litter can only be applied outside this schedule in the case of an emergency, which is expanded upon below (VADEQ, n.d.).

Strengths:

Anyone land-applying litter is required to meet certain waste storage requirements, since litter is often stored before application. Storage facilities must prevent contact with surface water and groundwater (VADEQ, n.d.), which is more stringent than requirements for CAFO permits that fail to mention groundwater protection. Additionally, storage facilities must be covered or a certain distance from surface water, covered if outside more than 14 days, not placed over water tables less than one foot deep, and have an impermeable barrier placed underneath them if the groundwater table is less than 2 feet deep (VADEQ, n.d.). This helps reduce runoff, particularly from agricultural stormwater, which is not often regulated in VA (see "Stormwater Regulations" section). Additionally, there are land application setbacks that attempt to reduce runoff to surface waters when litter is applied. No litter can be applied within 100 feet of a well or spring, within 100 feet of surface water with no vegetated buffer, within 35 feet of surface water with a vegetated buffer, within 25 feet of rock outcroppings, within 200 feet of occupied dwellings, and there should be no discharge to sinkholes (VADEQ, n.d.).

Weaknesses:

Poultry litter producers/sellers are not required to record the exact locations of any litter recipients unless litter is transported under the Virginia Litter Transport Incentive Program (see below section) (VADEQ, n.d.). In fact, no information is recorded unless the entity is receiving more than 10 tons of litter in one year or less (VADEQ, n.d.). For context, this is enough litter to fill 10 full-bed pickup trucks. While the land applier is required to provide their address to the supplier (VADEQ, n.d.), this is often their mailing address and not the location of the litter land application. This prevents concerned parties from tracking where litter is land-applied unless it is applied under the Virginia Litter Transport Incentive Program. Additionally, there is concern that the terms of emergency land application of litter are not well defined. This could lead to over-application of the litter when appliers claim an emergency situation that does not actually exist.

Also, CAFOs applying litter to their own fields have more leniencies in soil and litter testing and nutrient levels than external recipients. If a CAFO applies litter to their own lands, there are no limitations on the amount of phosphorous and no requirement to monitor nitrogen in the soil (9VAC25-630-50). This presents serious nutrient runoff risks as phosphorous and nitrogen can accumulate in the soil over time without testing requirements and pose a risk to groundwater if fields become oversaturated with nutrients. Finally, as with other testing protocols, there is no standard methodology for the litter and soil testing required for litter land application. This can lead to testing inconsistencies between farms and inaccuracies.

<u>Virginia Litter Transport Incentive Program:</u>

VADCR partners with the Virginia Poultry Federation to oversee a “poultry litter transport incentive program” that moves litter around the Commonwealth in an effort to provide nutrients to those areas where they are most needed (VADCR, n.d.-b). The incentives specifically aim to export litter from poultry-producing counties and away from the Chesapeake Bay watershed (VADCR, n.d.). The program provides monetary assistance to move the litter over large distances (VADCR, n.d.). The farther the litter is moved, the greater the compensation (VADCR, n.d.).

Only poultry litter from Page, Rockingham, and Accomack counties is eligible for this incentive program (VADCR, n.d.). Up to 800 tons of litter can be delivered to eligible applicants per year, and that litter usually must be analyzed (within the past three years) for nutrient content (VADCR, n.d.). No mortalities can be shipped through this program (composted or otherwise) and litter off-loading and storage must comply with appropriate regulations (see “Raw Litter Application Regulations” section) (VADCR, n.d.). There can be no loss of poultry litter during transportation and VADCR may check for compliance with any of these regulations (VADCR, n.d.).

Strengths:

An NMP must be prepared by a VADCR certified planner for all fields that receive poultry litter through this program (VADCR, n.d.). This is a stricter requirement than for local poultry litter application and helps protect water resources by requiring mitigation efforts, specific storage facilities, etc. (see “Nutrient Management Plans” section). Additionally, all fields eligible for payment through this program must have a Virginia Tech soil phosphorous test reading below a specific threshold (VADCR, n.d.). This helps protect against the type of phosphorous build-up observed in MD due to litter application (Chesapeake Bay Foundation, n.d.). This also is a much more reliable test than simply having farmers or land appliers test their soil since it is conducted by scientists who specialize in soil and nutrients at Virginia Tech Cooperative Extension.

Weaknesses:

While most litter must be tested for nutrients within the last three years before it is eligible for transport under this program, if nutrient levels are unknown, poultry producers are able to use a standard table to estimate nutrient levels and develop appropriate NMPs (VADCR, n.d.). While this expedites the application process, it is unclear how much follow-up exists to conduct actual nutrient testing after the application has been approved and as the NMP is being finalized. This may lead to nutrient overapplication if follow-up is poor. Additionally, there are no clear requirements on what nutrients should be tested in litter and no requirements for soil testing other than phosphorous. While some of this testing is laid out in other policies, without providing that information in these regulations, applicants and end-users may not know of the requirements and fail to accurately test necessary samples. This can also lead to the overapplication of nutrients in many instances.

Biosolids Program:

Biosolids regulation is much stricter than regulations surrounding raw litter application and therefore may provide some options for improving raw litter application policies. To apply biosolids to fields in VA, the land applier must meet specific standards (9VAC25-32-560). The land application site must be at least 18 inches above bedrock and the water table at the site at least 18 meters from the ground surface (9VAC25-32-560). When an individual qualifies for land application, there are strict requirements for how biosolids may be land-applied depending on the nature of the biosolid. Liquid biosolids cannot be applied in amounts exceeding 14,000 gallons/acre/application, must be uniformly applied to fields, and must have "sufficient drying time" between applications (9VAC25-32-560). For all other biosolids, no application can take place on slopes greater than 15% without stormwater mitigation; they can only be applied to snow if the snow is less than one inch thick and biosolids are incorporated within 24 hours; and they must be applied with setbacks from groundwater and surface water sources (9VAC25-32-560). Additionally, the biosolids themselves must meet certain standards to be applied to agricultural fields (9VAC25-32-357), and biosolids cannot be staged unless they are ready for application (9VAC25-32-545). When biosolids are staged, they can only remain unapplied for a maximum of seven days, depending on topography (9VAC25-32-545). If the biosolids cannot be applied in that timeframe, they must either be covered so there is no contact with precipitation or spread/removed as soon as possible (9VAC25-32-545). The staging area must prevent discharges, and any land applier must hold a valid certificate of competence regarding biosolids according to the VA Pollution Abatement Permit Regulation guidelines (9VAC25-32-545; 9VAC25-31-485). Finally, an NMP is required for the application of biosolids if that application takes place on a CAFO or on mined or disturbed land, or if biosolids will be applied more than once every three years (9VAC25-32-410).

Strengths:

Unlike raw litter applications, biosolid applications to land must specify the receiving fields, give notice to the local government of the application, post signs about the application, and respond to any substantive complaints from the community regarding the application (9VAC25-31-485). This not only involves the community in the process but allows qualified individuals to track where biosolids are being moved and applied and therefore better identify any resulting issues from biosolids application. Additionally, requiring the land applier to hold a valid certificate of competence regarding biosolids helps ensure that application is done properly and discharges to waterways are minimized. Finally, if phosphorous levels in receiving fields exceed 135 ppm (mg/kg), VADCR must approve the NMP used on-site (9VAC25-32-410).

This specifically targets the overapplication of phosphorous to the land surface, a documented issue in MD (Chesapeake Bay Foundation, n.d.), and works to prevent phosphorous build-up that can lead to leaching and runoff.

Weaknesses

There are multiple regulations presented in this policy that could be explained in more detail to ensure proper cooperation. For example, while liquid biosolids must be applied with "sufficient drying time" in between applications (9VAC25-32-560), that drying time is not specified in the policy. Perhaps this is described in the competency training for land appliers, but a minimum timeframe could be provided in the policy to ensure proper compliance. Additionally, limiting biosolids staging time may lead to a greater impact on the watershed if biosolids are applied hastily to avoid consequences. This is an issue often seen with litter application as specific storage requirements must be met if litter remains outside for more than 14 days.

<u>Maryland's Policies:</u>

Because MD also has a large poultry industry, decision-makers have developed significant policies to regulate poultry CAFOs and litter application. Much of MD's poultry industry is sited on their portion of the Eastern Shore. Thus, conditions of production and resultant pollution are similar to those on VA's Eastern Shore. MD has accomplished significantly more data collection than has taken place on VA's Eastern Shore, so the following policies are based on a larger scientific basis than many in VA. These policies can therefore be considered as a model for poultry regulation in VA.

Manure Transport Program

MD's manure transport system covers the cost of transporting litter to low phosphorous fields and to alternative use facilities (Md. Code Regs. §15.20.05.01:15.20.05.16). MD has documented issues with phosphorous overapplication following years of unregulated litter use (Chesapeake Bay Foundation, n.d.), so its manure transport program attempts to distribute phosphorous from areas of high to those of lower soil concentrations (Md. Code Regs. §15.20.05.01:15.20.05.16). All litter must come from broiler chicken farms and be transported more than seven miles from the originating farm (Md. Code Regs. §15.20.05.01:15.20.05.16). There are biosecurity measures in place that require litter to be covered during transport and include a ban on transporting incompletely composted dead birds (Md. Code Regs. §15.20.05.01:15.20.05.16). Each receiving site is evaluated to ensure there are no risks to the environment if litter is land-applied (Md. Code Regs. §15.20.05.01:15.20.05.16). All transported litter must be tested for nutrients within the last two years or the distributor will be fined, and details on litter recipients must be reported (name and address, name of contracted commercial poultry producer providing litter, and signed receiver statement that fields are not phosphorous saturated) (Md. Code Regs. §15.20.05.01:15.20.05.16). The program allows the litter to be transported by rail outside the Chesapeake Bay watershed and specific Eastern Shore counties have more cost-share available to ship away litter (Md. Code Regs. §15.20.05.01:15.20.05.16). Every applicant, whether fast-track or regular, must pay a bond that is only returned upon successful completion of the program; the bond is based on the estimated cost of remediation if an issue should occur during application (Md. Code Regs. §15.20.05.01:15.20.05.16). Commercial producers cannot force or penalize end-users for participation in the program (Md. Code Regs. §15.20.05.01:15.20.05.16).

Nutrient Management Plans

In MD, all farmers grossing at least $2500 per year or producing livestock of 8000 pounds or more live animal weight must have an NMP (Maryland Department of Agriculture, 2021). This requirement is not specific to CAFOs or to poultry litter application and includes all fertilizer types. NMPs must include stream setbacks, livestock exclusion from contact with surface waters, and management of high phosphorous fields (Maryland Department of Agriculture, 2021). All NMPs must be developed by academic advisors with the University of Maryland Extension, private consultants, or certified farmers (Maryland Department of Agriculture, 2021). To become certified, farmers must attend a two-hour nutrient applicator training course at least once every three years (Maryland Department of Agriculture, 2021). All plans are “science-based” and incorporate specific soil nutrient test requirements (Maryland Department of Agriculture, 2021). Plans are valid for 1-3 years and then require renewal. There are specific requirements for soil and litter testing under NMPs, including that soils must be tested at least once every three years and litter once every two years (Maryland Department of Agriculture, 2021). The nutrient management division at the University of Maryland can provide assistance when requested (Maryland Department of Agriculture, 2021). Additional requirements for NMPs include restrictions on nitrogen and phosphorous application depending on soil levels; using cover crops if litter is applied to fallow grounds; injection of litter into the soil (incorporated within 48 hours of application); and a time of year restriction for all nutrient applications (Maryland Department of Agriculture, 2021). Interestingly, litter application is not time of year restricted aside from December 16 to February 28 enforced for all nutrient applications (Maryland Department of Agriculture, 2021). Additionally, temporary field stockpiling of litter is allowed under specific circumstances to avoid overapplication (Maryland Department of Agriculture, 2021). To be eligible for field stockpiling, all litter storage structures must be filled, the start date of stockpiling recorded, application must take place by the following spring, the stockpile must be set back from water resources, the stockpile must be no less than six feet tall, the stockpile must be peaked to shed rainfall, and upon removal the ground must be cleaned and scraped (Maryland Department of Agriculture, 2021). If there is any evidence of nutrient runoff, the stockpile will no longer be allowed (Maryland Department of Agriculture, 2021). Maryland also has a phosphorous management tool to reduce overapplication. Regulations require farmers with high phosphorous soils to use the management tool to identify potential phosphorous loss risks and prevent additional buildup (Maryland Department of Agriculture, 2021). According to the University of Maryland, “soils with high phosphorous levels are typically found on farms that have used manure or poultry litter as a crop nutrient over an extended period of time” (Maryland Department of Agriculture, 2021).

<u>Recommendations:</u>

The following recommendations are based on the above policy review and the opinions expressed in a poultry stakeholder panel held at the Virginia Institute of Marine Science (VIMS) in the fall of 2022. The panel included individuals from Virginia Poultry Federation, Virginia Farm Bureau, VADEQ, VIMS, and the Delmarva Land and Litter Collaborative. All recommendations provided are consistent with achieving the Chesapeake Bay Program goals for the Bay, namely the goal of reducing nutrient runoff (*2025 Watershed Implementation Plans (WIPs)*, n.d.). **The recommendations are those of the individual authors alone and do not reflect official positions of the Virginia Institute of Marine Science or Chesapeake Bay Foundation.**

Recommendation 1: Require a greater description in existing policies and regulations on what weather conditions are appropriate for land application of litter.

Under current regulation, land application timing is restricted, but restrictions appear to be based on growing seasons for various crops (VADEQ, n.d.-b). This fails to consider the impact of precipitation on potential nutrient runoff; precipitation is often the cause of agricultural stormwater discharges, and such discharges are not well regulated in VA (Elrashidi et al., 2013; VA Stormwater Management Act, §62.1-44.15:24-62.1-44.15:34). Therefore, language should be added to regulation to address what weather conditions are appropriate for the land application of litter. A suggested addition is that land application should not take place if precipitation is forecast in the next 24 hours and should be avoided whenever possible if precipitation is forecast in the next 48 hours. If this was added, farmers would benefit from reduced litter sludge running across crop fields, enhanced nutrient application education and farm sustainability. This is on top of the aquatic health benefits of less nutrient runoff to surface waters and nutrient infiltration to groundwater, since both these processes can be precipitation driven (Diego-Feliu et al., 2022; Dzhamalov & Zlobina, 1994; Elrashidi et al., 2013).

Recommendation 2: Add approved labs and methodologies for soil and litter nutrient testing to existing policies and regulations.

Current regulation lacks a standard methodology for soil and litter testing (e.g. for qualification under the Virginia Litter Transport Incentive Program, for land application of litter, etc.) (VADCR, n.d.-b; VADEQ, n.d.-b). While recommended labs are provided to nutrient management planners to carry out NMPs (VADCR, n.d.-a), a specific list of approved labs and methodologies would reduce analytical inconsistencies. Therefore, a list of approved labs and methodologies should be added to regulations for the Virginia Poultry Litter Transport Incentive Program, 9VAC25-31-200, and 9VAC25-360 (VADEQ factsheet on litter use and storage). Benefits for farmers would include easy identification of certified labs for testing, better knowledge of litter nutrient contents being sold or supplied, and better knowledge by end-users of the agronomic needs of their crops. Benefits for the aquatic environment include reduction in nutrients entering the Bay watershed and better knowledge of what fields are over- and undersaturated with nutrients, allowing mitigation of potential negative impacts from overapplication.

Recommendation 3: Provide guidelines for safe litter transportation to avoid spills and increase transporter confidence.

While VADEQ currently provides a pamphlet on whom to contact if a spill occurs during transport (VADEQ, n.d.-c), no guidance is provided on how to avoid spills. Therefore, specific guidelines on this topic, including techniques to safely enclose and cover litter and check for litter leaks before transportation is initiated, should be added to Virginia Poultry Litter Transport Incentive Program information. This will enhance transporter confidence, ensuring loaded litter reaches its destination, and reducing public concerns over poultry spills. Anecdotal evidence suggests that the public may be more concerned about poultry spills than is warranted as DEQ records show only one spill on the Eastern Shore in the past year (Cline, 2022). Benefits to aquatic health include reduced nutrient runoff to surface waters.

Recommendation 4: Enhance the quality of nutrient management plans for farmers and nutrient tracking.

NMPs are currently only required for poultry litter application while all other fertilizer application types are exempt from this requirement. Additionally, while certification is required under many circumstances to develop NMPs (e.g. the Virginia Litter Transport Incentive Program) (VADCR, n.d.-b), it is not regulated across the board. On top of this, NMPs are only publicly available for permitted CAFOs, and then typically only via the FOIA process. Suggested changes include requiring certification to develop NMPs, making all NMPs publicly available, and requiring NMPs for all farmers grossing above $2500 annually or rearing livestock with live animal weights greater than 8000 lbs. regardless of fertilizer type. These NMP benchmarks are required in MD (Maryland Department of Agriculture, 2021). This would reduce nutrient runoff to surface waters and infiltration to groundwater and result in more effective fertilizer use, enhanced tracing of nutrient anomalies and public nutrient application education. These changes would benefit farmers by enhancing nutrient application education, the efficiency and effectiveness of nutrient application, crop yields, and reducing public pressure around nutrient runoff and infiltration.

Recommendation 5: Reform litter transportation tracking to include the locations where poultry litter is land-applied.

Under current policies, litter transport tracking is not straight-forward, leading to confusion on what information is tracked when litter is transported to end-users. According to DEQ data on litter land application from February 2020 to May 2022, the only information recorded when litter is land-applied is the locality and the nearest water body. More information is recorded on the source/broker of the litter, including an exact address, but the addresses provided for end-users are simply mailing addresses, not application locations. Therefore, the suggested change would require reporting of GPS coordinates for all locations where litter is land-applied. This benefits farmers in that they need only report one simple metric instead of multiple when they land-apply litter, and it creates potential for increases in cost-shares under the Virginia Poultry Litter Transport Program by better defining how far litter must travel between sources and the end-users. Benefits for the environment include an enhanced ability to manage nutrient runoff and infiltration because nutrient application locations are better understood, and an enhanced ability to trace excessive nutrient applications, allowing opportunities to better manage these resources.

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