More Phosphorus, Less Monitoring

MARYLAND'S MANURE OVERLOAD CONTINUES AS EASTERN SHORE POULTRY INDUSTRY EXPANDS AND STATE CUTS WATER QUALITY MONITORING

ENVIRONMENTAL INTEGRITY PROJECT

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NOTE

Minor corrections were made to the text of this report on October 22, 2015 in order to provide the most accurate information.

THE ENVIRONMENTAL INTEGRITY PROJECT

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Executive Summary

Poultry operations on Maryland's Eastern Shore continue to spread chicken litter loaded with phosphorus onto croplands that already have too much, according to the latest data from reports filed by farmers. Nearly four-fifths of the phosphorus from chicken litter that poultry operators applied to crops went onto fields that had "excessive" soil phosphorus levels, as defined by the Maryland Department of Agriculture's Nutrient Management Manual.

These practices deserve close scrutiny because over 200 new poultry houses have been permitted for construction since November 2014 but are not yet operating on the Delmarva Peninsula.[1] The growth of the poultry industry makes it harder to understand why last year, Maryland eliminated almost 60 percent (9 of 16) of its water quality monitoring sites that measured phosphorus pollution in rivers that run through the center of the Eastern Shore's poultry industry and into the Chesapeake Bay.[2] Improved monitoring is essential to determine if the state's new phosphorus control regulations are working to reduce runoff from agriculture, which is the largest single source of pollution in the nation's largest estuary.

To address the problem of phosphorus pollution from the poultry industry, Maryland Governor Larry Hogan's administration on June, 8, 2015, enacted new regulations to reduce the over-application of manure as fertilizer to farm fields. The new rules will slowly begin to limit application of poultry litter to soils that have too much phosphorus through the use of a formula called the Phosphorus Management Tool. However, the industry's growth may offset the benefits of the new regulations. For this reason, Maryland should consider a moratorium on the permitting and construction of new poultry houses until the phosphorus pollution problem is under control. Some residents of Somerset County, where 67 to 70 new poultry houses are permitted for construction, have called for a moratorium.[3]

Every year, Maryland's large poultry operations file with the state documents called annual implementation reports that detail the amount of phosphorus in poultry litter applied to crops onsite, and how much is needed for plant growth given soil conditions. The reports also identify the phosphorus content and the destination of any poultry litter shipped offsite.

The latest available annual reports from eight Eastern Shore counties, covering the 2013 calendar year, reveal that:

- Ninety three poultry operations reported spreading poultry litter containing 886,158 pounds of phosphorus to more than 18,000 acres in 2013. Seventy nine percent of that phosphorus was spread on soils that already contained an "excessive" amount of phosphorus, based on soil phosphorus concentrations reported by farmers. Soils with "excessive" phosphorus have fertility index values greater than 100, according to the Maryland Nutrient Management Manual.

- Twenty-six poultry operations spread 6 percent of the total phosphorus to 1,312 acres of cropland where phosphorus levels are so high that application of more phosphorus is now banned by new state regulations.

- Three hundred and sixty-one poultry operations exported 215,349 tons of poultry litter containing over 5 million pounds of phosphorus to other destinations in 2013. Of the total phosphorus exported, 73 percent went to other farmers, largely on the Eastern Shore; 20

percent went to manure brokers; 7 percent went to a fertilizer processing company called Perdue AgriRecycle; and 4 percent could not be tracked at all based on limited information provided by poultry operations. Crop farmers that import poultry litter do not have to report field-level information about the nutrients they actually apply to crops.

The annual reports were filed by 498 poultry operations in Kent, Queen Anne's, Caroline, Dorchester, Talbot, Wicomico, Worcester, and Somerset Counties. These operations reported a 2013 annual production of nearly 277 million broilers. The expansion of the industry on the Eastern Shore could create more waste than the state can deal with and still meet U.S. Environmental Protection Agency pollution limits for the Chesapeake Bay.

Agriculture accounts for 55 percent of the phosphorus pollution that stimulates algal blooms and robs the Bay of the oxygen needed to support aquatic life, and poultry litter accounts for most of the phosphorus runoff on Maryland's Eastern shore. The waters of the Eastern Shore should be clean enough to sustain rather than threaten the habitat that oysters, crabs, and fish need to thrive. Yet phosphorus concentrations in Eastern Shore rivers and streams remain unacceptably high, and either increased or remained stagnant between 2003 and 2013, according to the state's own monitoring data.[4]

Incredibly, the state shut down 9 of its 16 routine water quality monitoring stations on the lower Eastern Shore in December 2013, citing state budget cuts. Among the stations eliminated were two out of three on the Pocomoke River (a site of toxic algal blooms and fish kills during the Pfiesteria crisis of 1997), and all sites serving the Transquaking River. Reduced monitoring will make it much harder to determine whether the state's new efforts to limit runoff pollution with the Phosphorus Management Tool are working or need to be strengthened.

Maryland should take the following steps to address the problem:

- State officials should immediately restore funding and resume water quality monitoring where cutbacks occurred in Eastern Shore rivers. Eliminating this vital data is penny-wise and pound foolish, and will harm Chesapeake Bay restoration efforts.

- Maryland should require all farms on the Eastern Shore to identify where their poultry litter is applied, how much phosphorus it contains compared to soil concentrations, and the amount recommended for healthy crops. That level of information is currently required only for large poultry operators that apply litter to their own fields. But the data shows that the majority of the litter "exported" to other farms ends up on Eastern Shore farmland anyway, often within the same county and still within the Bay watershed.

- The poultry industry appears poised for an expansion in Somerset County that could significantly increase bird and waste production. Given the magnitude of the phosphorus problem on the Eastern Shore and in the Bay watershed, Maryland should consider a moratorium on further permitting or construction of poultry houses until the state fully implements the Phosphorus Management Tool and can demonstrate that it has the manure overload problem under control.

Aerial photograph taken in May, 2008, showing industrial chicken operations along the Pocomoke River in Somerset County, Maryland, immediately up-stream from discontinued water quality monitoring location, number POK0087.

The Phosphorus Problem

The Eastern Shore of Maryland is home to eight major rivers that empty into the Chesapeake Bay: the Sassafras, Chester, Choptank, Nanticoke, Pocomoke, Manokin, Wicomico, and Transquaking rivers. Due to hydrology, soil conditions, and land use practices on the Eastern Shore, agricultural runoff from this region flows easily into the Bay's tidal waters.[5] According to the U.S. Geological Survey, these factors have also caused the region to contribute a disproportionate amount of nutrients to the Bay, even though the Eastern Shore only represents seven percent of the watershed.[6] Most Eastern Shore rivers and streams are considered impaired under the federal Clean Water Act, largely due to impacts from agriculture.[7]

In the Chesapeake Bay, phosphorus fuels algal blooms that smother underwater grasses and produce low-oxygen "dead zones" that can kill fish and other aquatic species. Phosphorus enters surface waters through sediment runoff and can move into and through shallow groundwater under specific soil conditions. Soil phosphorus concentrations, agricultural practices, and other site-specific characteristics influence how phosphorus enters waterways. Several risk factors for phosphorus runoff exist on the Eastern Shore, and over the past several decades, phosphorus levels in soil have continued to increase as farmers spread poultry litter in excess of crop needs.[8]

In Maryland, the amount of soil phosphorus available to crops is expressed as a fertility index value. Fertility index values for phosphorus are grouped into four categories: low, medium, optimum, and

excessive. These categories indicate how crops will likely respond to additional phosphorus applications based on existing soil conditions. Low and medium values range from zero to 50, and indicate that additional phosphorus would help plants grow. Optimum values range from 51 to 100, and indicate that existing soil phosphorus is sufficient to support plant growth. Excessive values are higher than 100, and they indicate that soil already contains more than enough phosphorus. Maryland's Nutrient Management Manual recommends no additional phosphorus applications to fields with excessive fertility index values.[9]

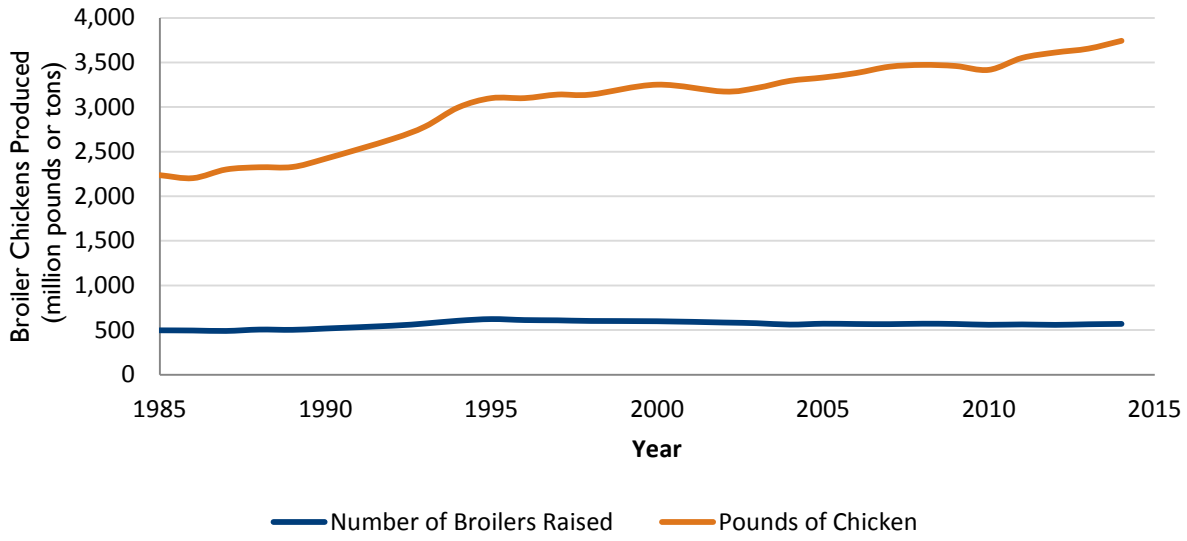
According to the U.S. Geological Survey, poultry litter is the most common fertilizer used on the Eastern Shore, and it has been applied at rates that far exceed crop needs for phosphorus since the 1980s.[10] Although manure contains both phosphorus and nitrogen, farmers often apply it to their fields at rates to meet crops' nitrogen needs, not their phosphorus needs. This results in over-application of phosphorus, which then builds-up in soil and runs off into waterways. Decades of over-application of poultry litter has developed into a legacy problem that will take decades to mitigate, as phosphorus applied years ago continues to run off into waterways.[11]

To address the water quality problems caused by phosphorus, the Maryland Department of Agriculture in June 2015 issued regulations that aim to reduce phosphorus applications to crops-- and the amount of phosphorus entering the Chesapeake Bay-- through the adoption of the "Phosphorus Management Tool." Between 2017 and 2022, most farmers will be required to use the tool to evaluate where phosphorus applications threaten water quality and determine where to reduce their phosphorus use. In addition to these phased-in limits on application, the rules ban phosphorus applications to fields with extremely high phosphorus levels—those with fertility index values over 500.[12]

More Chicken, More Waste

Despite high phosphorus concentrations in both soils and waterways, the poultry industry is growing on the Eastern Shore. While the total number of chickens has not increased dramatically, the average weight of meat chickens has increased by 46 percent between 1985 and 2014 to 6.58 pounds, according to annual data compiled by the Delmarva Poultry Industry, Inc.[13] This is important because larger chickens generally produce more waste than smaller chickens.[14] Poultry operations in the region produced more than 3.7 billion pounds of chicken in 2014, a 13 percent increase since 2004, and a 60 percent increase from production in 1985.[15] (Figure 1).

FIGURE 1. BROILER CHICKENS PRODUCED ON THE DELMARVA PENINSULA, 1985-2014



Between 2013 and 2014, the Delmarva peninsula gained 141 new poultry houses, and the upward trend is continuing.[16] Information from county zoning boards indicate that over 200 new poultry houses will likely be constructed by the end of 2015 in just three counties on the Delmarva peninsula. (Table A). A single poultry operation can have between two and 12 poultry houses, each with the capacity to house about 27,000 chickens at a time.[17] Poultry operations raise five flocks of chickens per year on average, so a single poultry operation with six poultry houses can raise around 810,000 chickens over the course of a year.[18]

Information from county zoning boards indicate that three counties on the Delmarva peninsula are experiencing rapid, localized growth in the number of chicken houses for which farmers are requesting local authorizations to begin construction. For example, by July 2015, Somerset County permitted for construction 67 to 70 new chicken houses on 18 properties. Some of these houses will be located at completely new operations, while others are being added to existing farms. In addition to Somerset County, Wicomico and Worcester Counties have experienced steady growth over the past several years.[19]

Growth of the industry is not limited to Maryland and this presents greater challenges for the Chesapeake Bay. Accomack County, Virginia, received 12 applications for an additional 84 new poultry houses between November 2014 and July 2015. Most of these are for new operations that would have between five and eight chicken houses each, and they will be built near Tyson Foods' nearby chicken processing plant. Kent County, Delaware has gained 50 new poultry houses since 2014.[20] Together, these new houses could add over additional 27 million chickens and associated waste to the region.

TABLE A. POULTRY HOUSES PERMITTED FOR CONSTRUCTION IN SELECTED DELMARVA COUNTIES, 2015[21]

County	Number of new poultry houses	Approximate number of additional chickens raised per year
Somerset, MD	67-70	9,045,000 - 9,450,000
Accomack, VA	84	11,340,000
Kent, DE	50	6,750,000
Total	201-204	27,135,000 - 27,540,000

The recent growth of the industry in the region can be attributed to the increase in value of poultry production over the past several years. According to data from the U.S. Department of Agriculture, the value of poultry production increased by 38 percent between 2005 and 2014.[22] (Table B). Increases in chicken consumption and exports to other countries also play a role.

TABLE B. POULTRY PRODUCTION AND VALUE IN MARYLAND, 2005-2014

Year	Number of broiler chickens	Weight (1,000 lb)	Value (1,000 dollars)	Dollars per pound
2005	289,500,000	1,389,600	639,216	0.46
2006	271,800,000	1,304,600	534,886	0.41
2007	294,800,000	1,591,900	732,274	0.46
2008	298,600,000	1,612,400	741,704	0.46
2009	291,900,000	1,401,100	640,303	0.457
2010	300,500,000	1,433,400	690,899	0.482
2011	311,100,000	1,648,800	756,799	0.459
2012	304,400,000	1,604,800	802,400	0.5
2013	305,200,000	1,617,600	980,266	0.606
2014	287,800,000	1,554,100	989,962	0.637

Water Monitoring Cutbacks

Between 2003 and 2013, the Maryland Department of Natural Resources (DNR) sampled water at 16 tidal water quality monitoring locations in five lower Eastern Shore rivers. The DNR stopped sampling at nine of these locations starting in 2014 due to a $48,000 cut in state funding.[23] (Figure 2). According to the DNR, the decision to stop sampling at these 9 locations would save $30,000 per year. Many of the discontinued stations were located close to poultry operations and crop farms where manure is spread as fertilizer. From 2003 to 2013, water samples indicated high levels of total phosphorus and showed no improvements over the decade, according to Chesapeake Bay Program water quality data. Phosphorus concentrations in two of these waterways actually increased.[24]

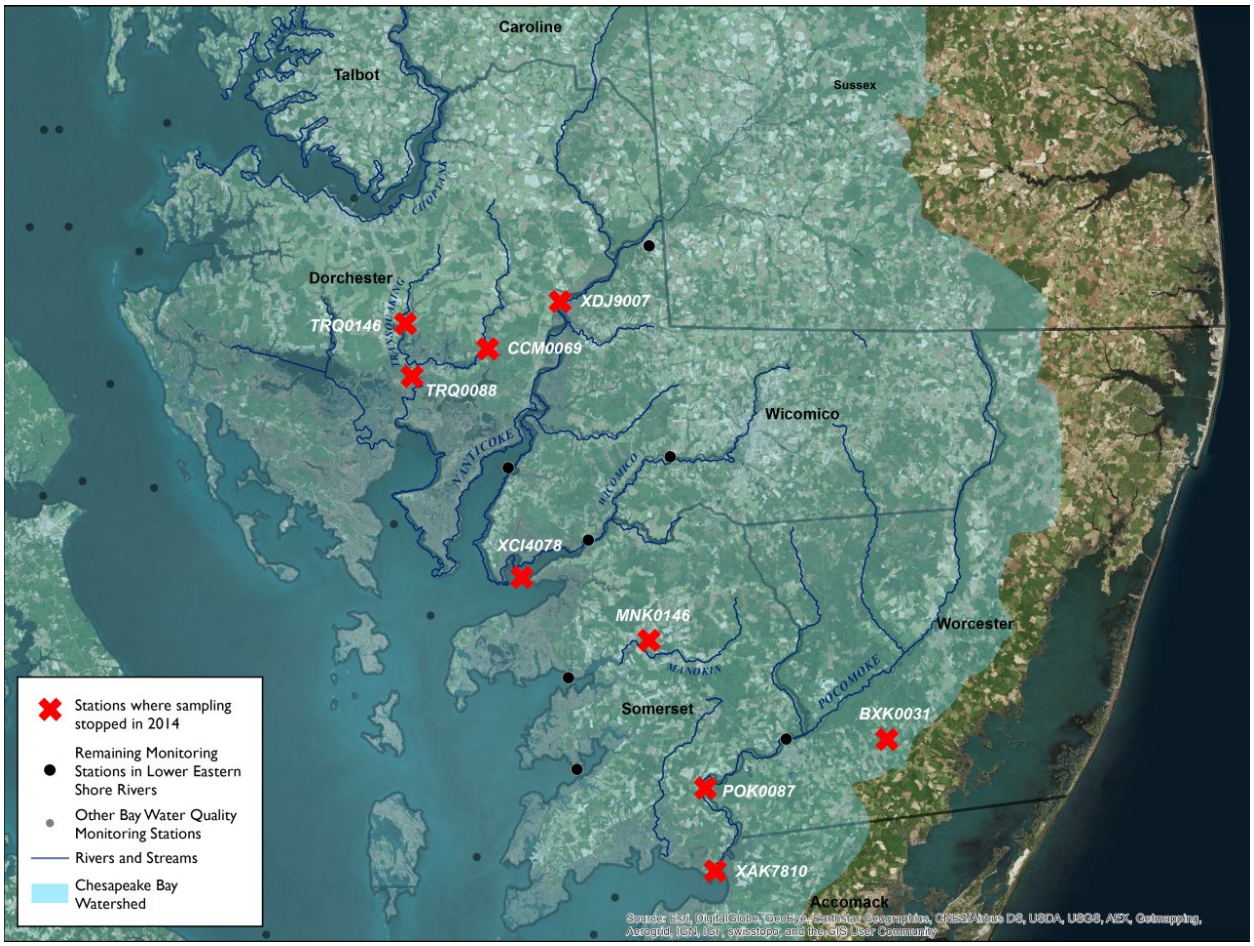
All sampling locations on the Transquaking river in Talbot County have been removed, and DNR's assessments indicate that 92 percent of the freshwater streams that feed it have been impaired due to agricultural pollution.[25] Additionally, two out of the three monitoring stations were removed in the lower Pocomoke River in Somerset County, where toxic algal blooms and fish kills occurred during the *Pfiesteria* crisis of 1997. Somerset County is where new poultry houses are now permitted for construction.

The nine discontinued stations became a part of DNR's routine tidal sampling program in 2003, after a number of large toxic algae blooms in the late 1990s.[26] Prior to conducting routine sampling in these locations, scientists and regulators lacked detailed water quality information about lower Eastern Shore rivers and called for an increase in monitoring.[27] The data collected helped inform current strategies to reduce water quality impacts from agricultural and poultry operations. Up-to-date data are still needed for measuring the long-term water quality impacts of Maryland's new phosphorus regulations, a growing poultry industry, and changes in agricultural practices.

The following is DNR's explanation, offered in August 2015, of why it stopped water quality monitoring at the nine monitoring locations:

> *Due to large reductions in our [state] monitoring funds we were forced to make some tough decisions concerning our State-wide water monitoring program. The elimination the nine temporary eastern shore monitoring sites was only part of the painful cuts that resulted in order to account for the loss in funding. So at this time we don't have the funds to restart those stations. However, we still have our long-term monitoring stations in those general areas so we can still assess nutrient and other water quality conditions, just not at the previous resolution.*[28]

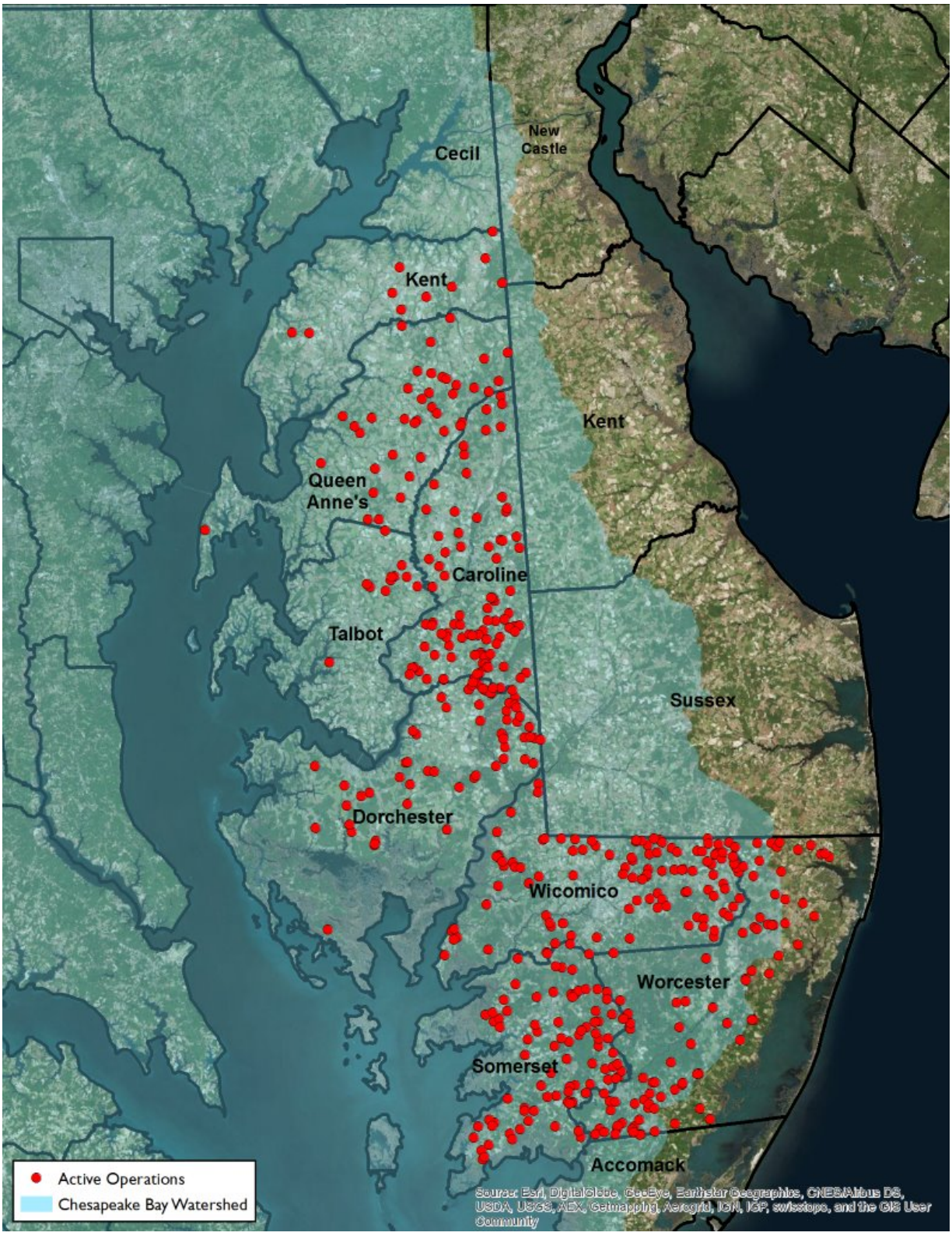
FIGURE 2. WATER QUALITY MONITORING STATIONS ON THE LOWER EASTERN SHORE



Analysis of Poultry Operations

Maryland's Water Quality Improvement Act of 1998 requires most agricultural operations in the state to obtain and follow nutrient management plans (NMPs) or comprehensive nutrient management plans (CNMPs). These operations must file annual implementation reports with the Maryland Department of Agriculture (MDA) each year, detailing on-the-ground activities from the previous calendar year.[29] In addition to other facts, the reports provide information about animal production, which poultry companies own the birds, manure and nutrient applications to on-site crops, and manure exported off-site. The following analyses are based on data from annual implementation reports filed by 498 poultry operations in Kent, Queen Anne's, Caroline, Dorchester, Talbot, Wicomico, Somerset, and Worcester Counties in 2013. (Figure 3). For more information about the methods used in this report, please refer to the methods section.

FIGURE 3. LARGE POULTRY OPERATIONS ON MARYLAND'S EASTERN SHORE



Chicken Production

Four hundred and ninety-eight poultry operations reported raising 276,989,155 chickens on their 2013 annual implementation reports. (Table C, Figure 3). However, this likely does not account for all of the chickens raised in large, industrial-scale facilities on the Eastern Shore that year. Annual reports for 20 poultry operations were not available, even though the operations raised chickens in 2013, according to the Maryland Department of the Environment's (MDE) online animal feeding operation status database.[30] Based on flock sizes reported in MDE's database and the average number of flocks raised by operations on the Eastern Shore, these operations likely raised over 12 million additional chickens.[31]

TABLE C. CHICKENS RAISED BY EASTERN SHORE POULTRY FARMERS, 2013

County	Number of Active Poultry Operations	Total Number of Chickens Raised
Caroline	89	38,751,600
Dorchester	63	32,113,440
Kent	10	5,298,000
Queen Anne's	40	23,113,900
Somerset	87	49,816,540
Talbot	10	4,685,300
Wicomico	113	57,845,325
Worcester	86	65,365,050
Total	**498**	**276,989,155**

Most Chickens Raised Under Contracts with Commercial Poultry Companies

Most Eastern Shore poultry operations raise chickens for at least one of five large poultry companies: Perdue, Tyson Foods, Mountaire Farms, Amick Farms, and Allen Harim Foods. (Table D, Figure 4). These companies, also known as "integrators," control the industry from the top down. In addition to slaughtering chickens and supplying them to local and global markets, these companies own the chickens and oversee all parts of a chicken's life. They contract with individual operators to house and raise their chickens according to detailed specifications. Once chickens are fully grown, poultry companies leave operators with the responsibility to manage the manure left behind.

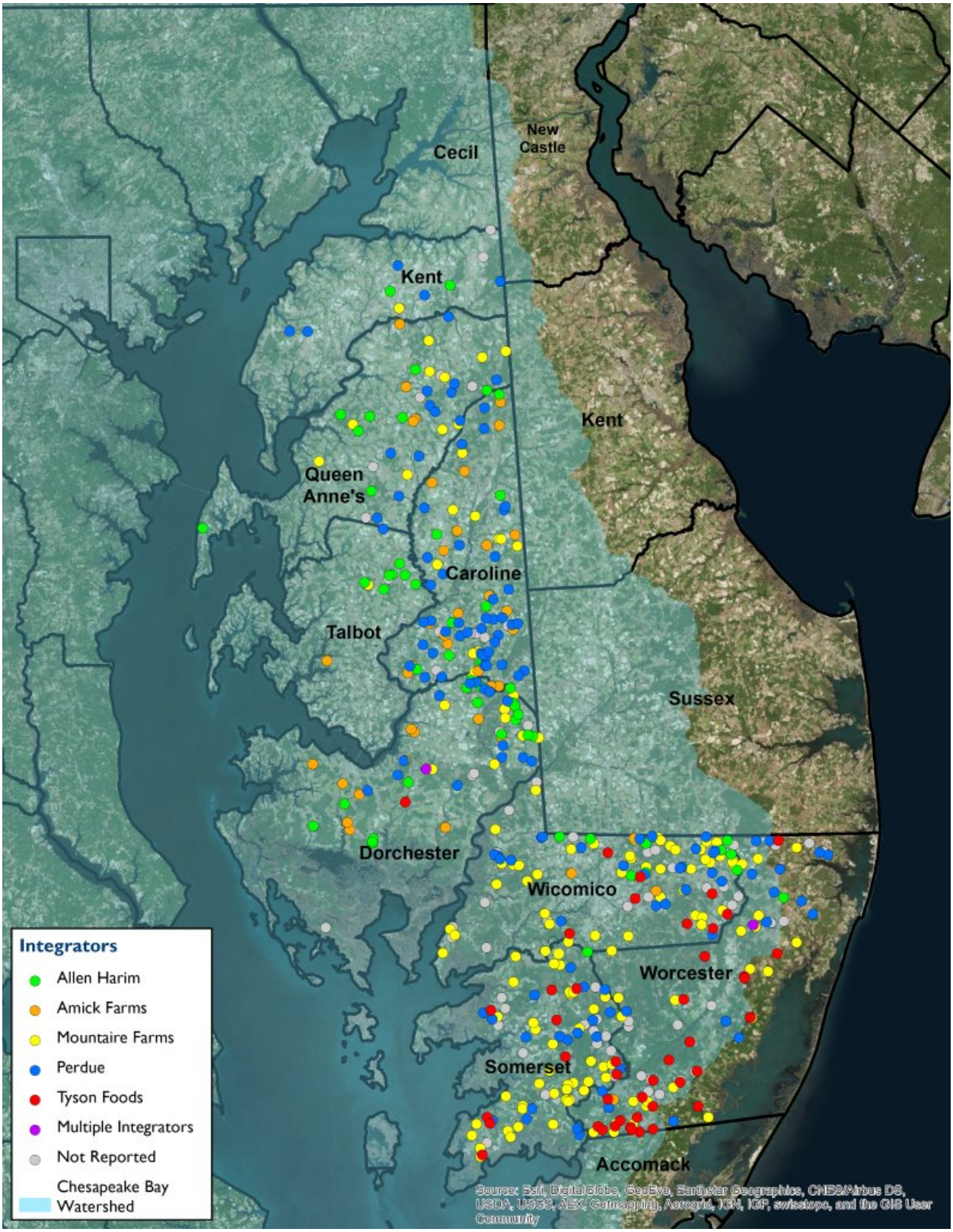
Based on integrators listed by poultry operations on their 2013 annual reports, 55 percent of the poultry operations on Maryland's Eastern Shore raised chickens for Mountaire Farms or Perdue. Table B shows the number of chickens raised under contracts and the number of operations controlled by each integrator. Fifteen percent of poultry operations did not list an integrator on their annual report.

TABLE D. POULTRY PRODUCTION BY INTEGRATOR, 2013

Company	Number of poultry operations	Share of operations	Number of chickens raised in 2013	Share of total number of chickens raised
Mountaire Farms	145	29%	77,411,525	28%
Perdue	132	27%	74,672,250	27%
Allen Harim Foods	56	11%	25,394,300	9%
Tyson Foods	46	9%	26,723,330	10%
Amick Farms	42	7%	21,728,890	8%
Multiple Integrators	2	<1%	1,576,000	<1%
Not reported	75	15%	49,482,890	18%
Total	498	100%	276,989,155	100%

State laws require the contract farmers, not the poultry companies, to manage the manure. In the 1990s, the MDA began a voluntary manure transport program that provides grants to farmers to move manure to locations where it is less likely to impact water quality. Commercial poultry companies are required to financially contribute to the program.[32] In fiscal years 2013 and 2014, poultry companies paid a total of $759,181.[33] However, in July 2014, Maryland enacted a law that shifted the burden to the MDA, and ultimately taxpayers, to foot more of the bill than poultry companies.[34] Poultry companies' contributions to the manure transport program, even if they covered all costs of the program, would be nominal compared to the over $980 million dollars companies earned from poultry sales in 2013.[35]

FIGURE 4. POULTRY OPERATIONS BY COMPANY, 2013[36]



Some Poultry Litter Applied to Crops On-site

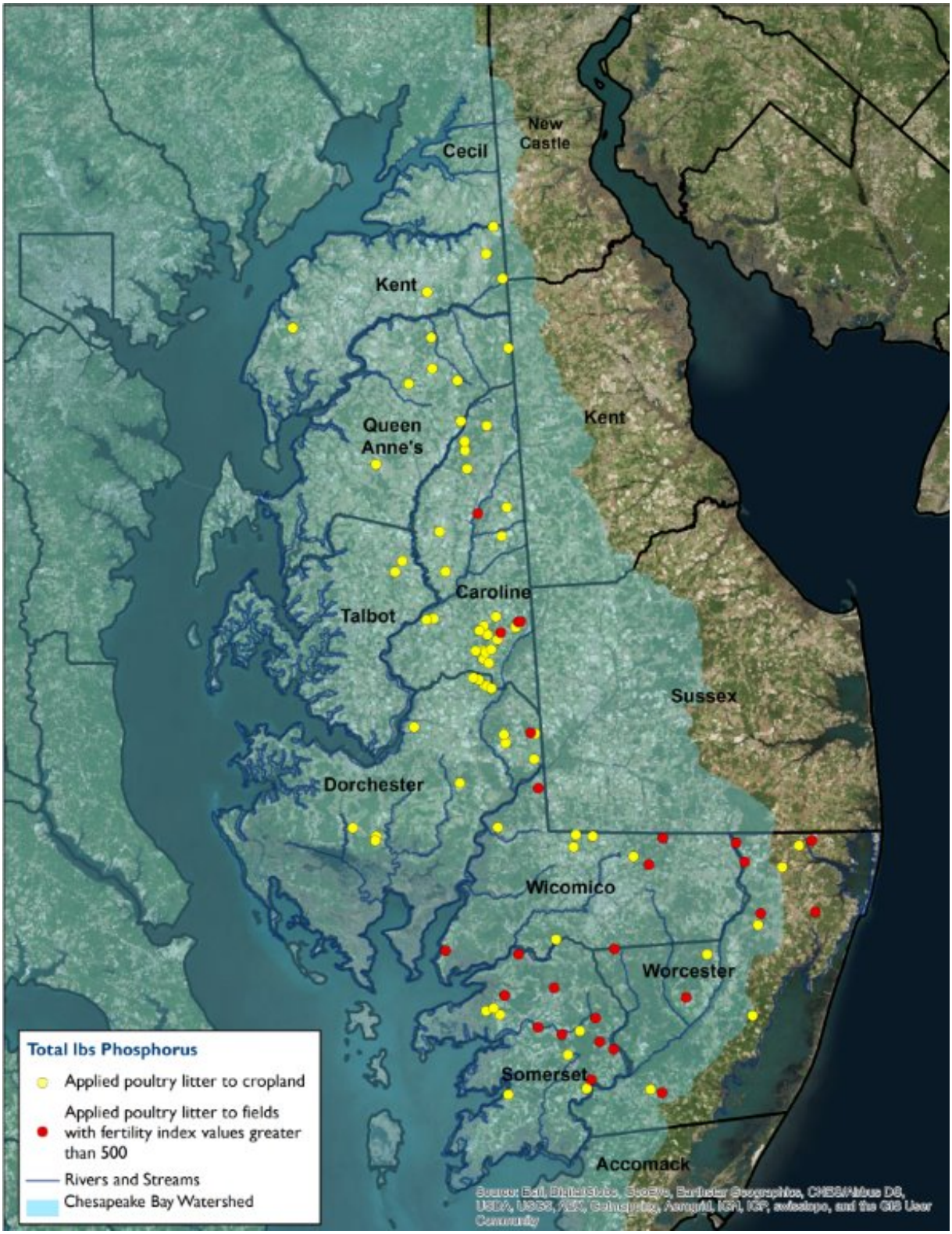
Ninety-three of the 498 poultry operations spread 886,473 pounds of phosphorus to over 18 thousand acres of cropland in 2013. (Table E, Figure 5). Of the total amount of phosphorus applied, 90 poultry operations spread 79 percent to fields with excessive phosphorus levels, where crops did not need it, according to recommendations in the Maryland Nutrient Management Manual.[37] These fields had fertility index values exceeding 100. Ten percent of the phosphorus applied to these fields went on 1,799 acres that also received manure in 2012.[38]

Twenty-six poultry operations applied six percent of the total phosphorus to fields that had fertility index values greater than 500, where such applications are now banned. These fields encompassed 1,312 acres and accounted for seven percent of the land to which poultry operations applied manure. While this practice was not prohibited in 2013, these fields will be off-limits to poultry litter application in 2015 if they continue to have extremely high soil phosphorus concentrations.

TABLE E. PHOSPHORUS APPLIED ON-SITE AT POULTRY OPERATIONS IN 2013

	Number of poultry operations	Acres	Percent of total acres	Phosphorus (lbs)	Percent of total phosphorus applied
Total phosphorus applied	93	18,413	100%	886,158	100%
Applied over crop needs[39]	93	18,005	98%	813,987	92%
Applied to fields with excessive soil phosphorus (FIV > 100)	90	14,806	80%	699,468	79%
Applied to fields where future applications will be banned (FIV > 500)	26	1,312	7%	54,759	6%

FIGURE 5. POULTRY OPERATIONS THAT SPREAD MANURE ON THEIR OWN CROPLAND IN 2013



Most Poultry Litter Exported to Crop Farms on the Eastern Shore

When poultry operations do not have enough land to which they can apply manure, they export it off-site. Three hundred and sixty-one poultry operations reported shipping 215,349 tons of poultry litter containing over 5 million pounds of phosphorus to other locations in 2013. (Table F). Most of the poultry litter shipped to farmers remained within the Chesapeake Bay watershed, according to destination addresses provided by poultry operations. (Figure 6).

TABLE F. MANURE AND PHOSPHORUS EXPORTED BY POULTRY OPERATIONS IN 2013

County	Farms Exporting/Total Poultry Farms	Manure Exported (Tons)	Phosphorus Exported (pounds)
Caroline	59/89	38,156	849,123
Dorchester	44/63	28,864	711,560
Kent	6/10	5,349	141,490
Queen Anne's	34/40	23,677	665,181
Somerset	58/87	33,542	835,693
Talbot	7/10	2,842	67,226
Wicomico	89/113	40,791	927,999
Worcester	64/86	42,129	986,908
Total	**361/498**	**215,349**	**5,185,180**

Based on the export addresses and the amount of manure exported by poultry operations, 73 percent of manure went to farms, 20 percent went to manure brokers, and 7 percent went to Perdue AgriRecycle, a poultry litter incinerator and pelletizing facility in Delaware. (Table G). Manure brokers facilitate manure transport between those who have it and those who need it, and they may stockpile manure until it can be sold elsewhere.[40] However, once a broker receives poultry litter, it is not possible to determine where it ultimately ends up based on the information provided by poultry operations alone.

Crop farmers who import poultry litter are only required to submit field-specific information about the amount of nutrients they plan to spread on their fields—not what they actually spread on each field. Their annual reports only require them to report nutrient applications at the crop level. But, crop-level information is kept anonymous under a state law that, in practice, conceals it from public view.[41]

TABLE G. POULTRY LITTER AND PHOSPHORUS EXPORTED TO FARMERS, MANURE BROKERS, AND PERDUE AGRIRECYCLE IN 2013

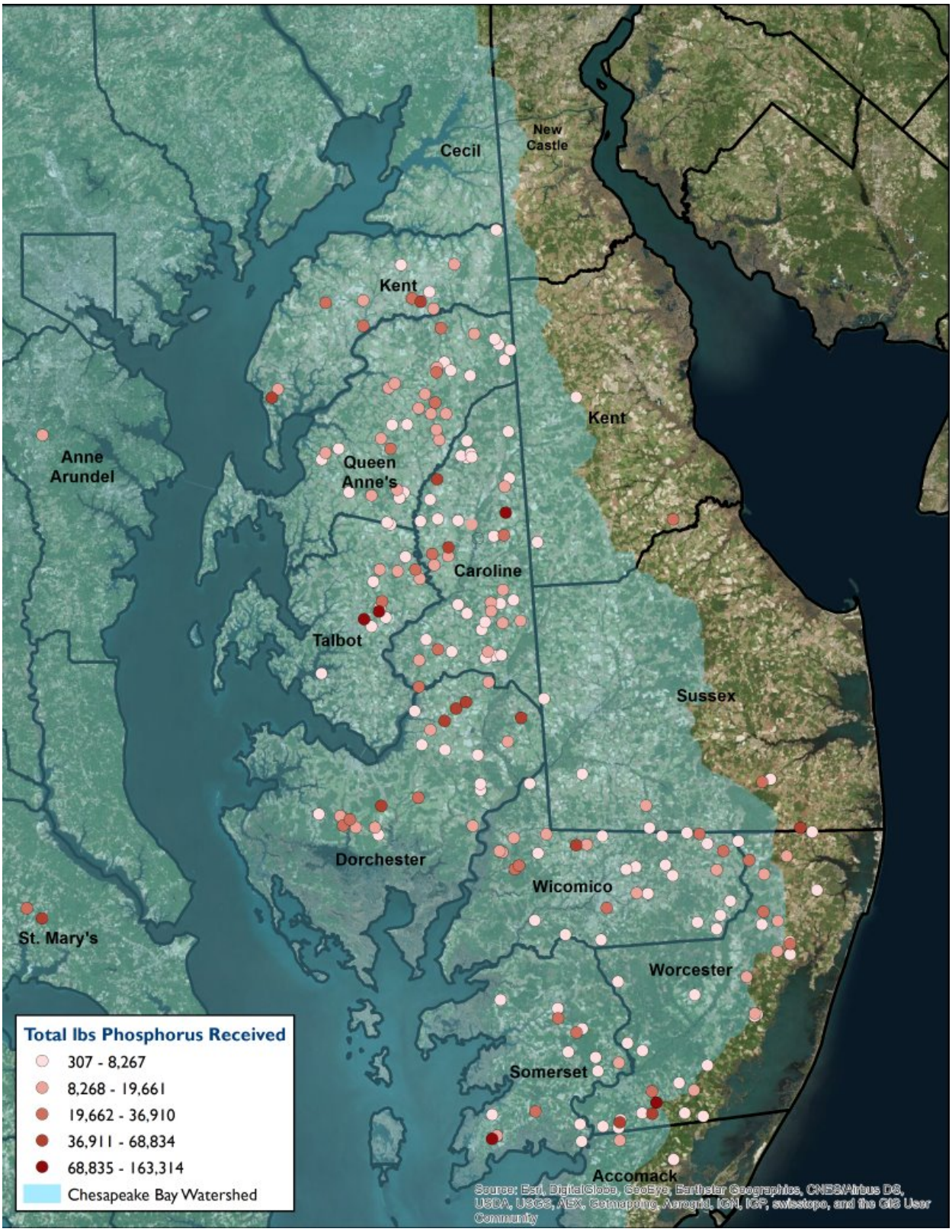
Recipient	Poultry Litter Received (tons)	Phosphorus Received (lbs)
Farmers	157,119	3,787,025
Brokers	42,857	1,025,179
Perdue AgriRecycle	15,374	372,976
Total	**215,350**	**5,185,180**

The lack of public information about how exported manure is ultimately used is a critical problem because exported manure represents a much greater volume of phosphorus than manure directly land-applied by poultry operations. Table H shows how much phosphorus poultry operations land-applied and an estimate of the amount received by crop farmers in each Eastern Shore county.[42] Only 20 percent of the phosphorus in poultry litter managed by Eastern Shore farmers can be tracked at the field level through publicly available annual reports. To date, the MDA has failed to track field-level nutrient applications by crop farmers and has failed to make related information available to the public.

TABLE H. MANURE PHOSPHORUS MANAGED BY POULTRY OPERATIONS AND CROP FARMERS IN 2013

County	Tracked: Phosphorus from poultry litter land applied by poultry operations (lbs)	Not Tracked: Phosphorus from poultry litter likely applied by crop farms in Eastern Shore counties (lbs)	Total (lbs)
Caroline	265,298	671,903	937,201
Dorchester	75,057	397,937	472,994
Kent	76,104	275,942	352,046
Queen Anne's	54,218	458,567	512,785
Somerset	119,085	592,368	711,453
Talbot	22,106	418,521	440,627
Wicomico	84,253	344,506	428,759
Worcester	190,037	480,075	670,112
Total	886,158	3,639,819	4,525,977

FIGURE 6. CROP FARMS THAT RECEIVED EXPORTED MANURE FROM LARGE POULTRY OPERATIONS IN 2013[43]



Conclusions & Recommendations

Despite clear evidence of an ongoing phosphorus pollution problem caused by the poultry industry and agricultural practices, budget cuts drove Maryland to blindfold itself by eliminating water quality monitoring sites just before taking meaningful steps to address the problem.

State officials should restore funding and resume water quality monitoring where cutbacks occurred in Eastern Shore rivers and streams as soon as possible. By reducing water quality monitoring in areas closest to the poultry industry, the state made it that much harder to identify, characterize, and reduce pollution loads. Data from the discontinued stations are critical to understanding the impact of the new phosphorus regulations and changing agricultural practices. Even though water quality monitoring requires long periods of time to detect meaningful changes, samples collected now could provide critical baseline data against which future progress can be measured. The cost of maintaining these sites is minimal compared to the amount of effort expended on policy solutions proposed to address phosphorus pollution.

Maryland should require all farms on the Eastern Shore to identify where their poultry litter is applied to farmland, how much phosphorus it contains compared to soil concentrations, and crop nutrient recommendations. This level of information is currently required only for large poultry operators that apply litter to their own fields. But the data shows that almost all of the litter "exported" to other farms ends up on Eastern Shore farmland anyway, often within the same county and still within the Bay watershed. When viewed alongside water quality results, field-level manure application and soil data provide valuable insight into how agricultural practices impact water quality. This kind of information should also be available to the public.

The state is allowing the poultry industry to grow at the same time it is reducing water quality monitoring and limiting access to agricultural information that could help show whether the Chesapeake Bay can sustain such growth. The poultry industry appears poised for an expansion in Somerset County that could significantly increase bird and waste production. Given the magnitude of the phosphorus problem on the Eastern Shore and in the Bay watershed, Maryland should consider a moratorium on further permitting and construction of new poultry houses until the state can fully implement the Phosphorus Management Tool and demonstrate that its manure overload problem is under control.

Ultimately, if Maryland is being asked to choose between clean water and more chickens, the state should choose clean water.

Methods

The analyses in this report are limited to 1) the information provided by regulated poultry operations on their 2013 Annual Implementation Reports (AIRs) and 2) the information available through MDE's online Animal Feeding Operation status database as of August 10, 2015. For our land application analyses, we used methods published in the Maryland Nutrient Management Manual developed by the University of Maryland Extension and soil test data provided in operations' CNMPs. While reviewing AIRs, we found some reporting deficiencies and inconsistencies and did not include incomplete or anomalous information in our analyses. Some of the limitations of the data underlying this report required us to make assumptions when necessary. Our methods and assumptions are discussed below.

Acquiring the Data

The Environmental Integrity Project (EIP) requested the 2013 Annual Implementation Reports from the Maryland Department of the Environment in December 2014 under Maryland's Public Information Act. The state finished complying with the request in June 2015. In total, EIP received 529 AIRs from poultry, dairy, and other industrial animal operations on the Eastern Shore. Four-hundred and ninety eight of these were active broiler operations.

Poultry Litter Land-Applied On-Site

The Environmental Integrity Project determined fertility index values (FIVs) corresponding to 911 fields based on soil phosphorus test results provided by poultry operations on their annual implementation reports. The Annual Implementation Report form ask operators to provide soil test results for each field that receives manure as phosphate in parts per million (ppm) or pounds per acre (lb/acre). However, based on a comparison with soil test lab results in the comprehensive nutrient management plans (CNMPs) for these operations, if available, EIP discovered that most operators reported phosphorus instead of phosphate. Some operators reported that their soil tests were for phosphorus, and some reported FIVs. Many operators did not report soil test units on their forms, so EIP consulted their CNMPs, when available, to determine which units to use. When needed, EIP calculated fertility index values according to methods outlined in the Maryland Nutrient Management Manual.[44] Table I shows the methods used to calculate fertility index values, depending on the types of information available for each poultry operation and field.

TABLE I. METHODS USED TO DETERMINE FERTILITY INDEX VALUES

Number of fields	Percent of total (of 911 fields)	Method Description
325	36%	The operator reported a FIV on their AIR, or the operator's soil tests matched those in their CNMP so FIVs were directly transcribed from their CNMP.
349	38%	EIP calculated the FIV and soil test units and/or soil test labs were the same as those reported in the operation's CNMP.
235	26%	Due to a lack of information at the time of this report, EIP assumed soil test lab was same as lab used for manure analysis and that operation reported phosphorus instead of phosphate. Assumed soil test units, when absent, were assumed to be those commonly reported by the lab that performed the manure analysis.

Exported Poultry Litter

EIP's analysis of manure exports is based on the total amount of manure exported and destination addresses provided by poultry operations. Poultry operations are not required to report the amount of manure they send to each destination address. As a result, to determine the amount of manure that was exported to each county and to each recipient, EIP assumed that listed recipients received the total amount of solid manure exported by the operation. If an operation exported to more than one recipient, EIP assumed that each recipient received an equal share of the total solid manure exported.

The phosphorus content of exported manure was obtained or calculated using manure analyses provided by poultry operations. Poultry operations are required to submit manure analysis lab sheets with their annual report forms and copy some information from their analyses onto part of the form. Not all operations submitted manure analyses. For these operations, EIP calculated the phosphorus content of the manure in pounds per ton wet weight, as-is, using the moisture content and percent phosphate (wet weight) provided by the operation on their annual report. For 28 operations that did not report any manure content information, EIP assumed that their poultry litter contained the average phosphate content reported by other poultry operations, 55.2 pounds of phosphate per ton of poultry litter.

Missing Operations

EIP relied on the MDE's online animal feeding operation status database to determine potential differences in the number of chickens raised by regulated poultry operations in 2013 And the number represented by poultry operations on their AIRs. EIP identified poultry operations by the primary animal types listed. In the five instances when the animal type was omitted in MDE's database, EIP determined the animal type using each operation's 2013 annual implementation report, if available. Some operations are listed twice in MDE's database, as the agency has added new records if operations file new notices of intent (NOI) to be covered by the state's general discharge permit for animal feeding operations. For its analysis of operations that existed in 2013, EIP limited records to operations that submitted NOI's during or before 2013. EIP estimated the number of chickens raised per year by multiplying the animal capacity by 5, which was the average number of flocks raised per year at the 498 active poultry operations for which annual implementation reports were available.

Maps

EIP generated all maps in this report using ArcMap 10.3 and geo-referenced operation and export destination addresses provided on annual reports. In instances in which addresses could not be georeferenced due to spelling or punctuation errors or missing information, EIP conducted additional online research and used MDE's online animal feeding operation database to determine corrected addresses. If an address could not be georeferenced after additional research, EIP excluded the operation from the map. Explore the interactive map at http://arcg.is/1POhHKM.

NOTES

[1] Tremblay, Kristen and Rich Morrison, County of Accomack Planning Report, "Poultry Houses in Accomack County" July 29, 2015. Available at: http://www.boarddocs.com/va/coa/Board.nsf/files/9ZCTUH791015/$file/2015.08.05%20BOS%20Poultry%20Report%20PACKET.pdf

[2] Email correspondences with the Maryland Department of Natural Resources, August 21, 2015; and Maryland Department of Natural Resources (May 31, 2015) Quality Assurance Project Plan for the Maryland Department of Natural Resourced Chesapeake Bay Water Quality Monitoring Program- Chemical and Physical Properties Component for the period July 1, 2015-June 30, 2016, pg. 5. Available at: http://mddnr.chesapeakebay.net/eyesonthebay/documents/MdDNR_MTQAPP2015.pdf; accessed on August 18, 2015.

[3] Memo to Somerset County Planner Gary Pusey from Assateague Coastal Trust and Food & Water Watch, may 7, 2015. See page 35. Available at: http://www.actforbays.org/coastkeeper/docs/Pusey%20packet%205.7.2015.pdf

[4] Environmental Integrity Project (July 2014) "Poultry's Phosphorus Problem", available at: http://environmentalintegrity.org/wp-content/uploads/Poultrys-Phosphorus-Problem.pdf

[5] Staver, Kenneth W. and Russell B. Brinsfield (2001) "Agriculture and Water Quality on the Maryland Eastern Shore: Where Do We Go from Here?" *BioScience*. 51:10. Pp. 859-868. Available at: http://bioscience.oxfordjournals.org/content/51/10/859.full; Ator, Scott W. and Judith M. Denver, U.S. Geological Survey. (2015) "Understanding Nutrients in the Chesapeake Bay Watershed and Implications for Management and Restoration," Circular 1406, Version 1.2, June 2015. Accessed August 10, 2015. Available at: http://pubs.usgs.gov/circ/1406 (Hereafter referred to as "USGS (June 2015)").

[6] USGS (June 2015)

[7] Maryland Department of the Environment (2012) Integrated Report Surface Water Quality Map: Nutrient Assessments. Accessed August 12, 2013. Available at: http://www.mde.state.md.us/programs/Water/TMDL/Integrated303dReports/Pages/NutrientsAssessmentMap.aspx

[8] Staver, Kenneth W. and Russell B. Brinsfield (2001) "Agriculture and Water Quality on the Maryland Eastern Shore: Where Do We Go from Here?" *BioScience*. 51:10. Pp. 859-868. Available at: http://bioscience.oxfordjournals.org/content/51/10/859.full; and USGS (June 2015).

[9] Maryland Nutrient Management Manual, Accessed July 10, 2015. Available at: http://mda.maryland.gov/resource_conservation/Pages/nm_manual.aspx

[10] USGS (June 2015)

[11] *Id.*

[12] COMAR 15.20.08, http://mda.maryland.gov/Documents/ProposedPMTRegs4.3.15Register.pdf

[13] Delaware Poultry Industry, Inc., Annual Industry Summaries. Accessed 8/13/2015, available at: https://www.dpichicken.org/faq_facts/docs/Delmarva%20Chicken%20Production%20Facts%201969-2014.pdf Weight includes broilers, roasters and Cornish hens. Delaware Poultry Industry data show that the average weight of meat chickens raised in Maryland and Virginia was 5.3 and 5.4 pounds, respectively, while chickens raised in Delaware weighed 7.1 pounds on average. http://www.dpichicken.org/faq_facts/docs/factsde2013.pdf

[14] Based on as-excreted manure production equations relying on the live weight of chickens. American Society of Agricultural Engineers (2005) "Manure Production Characteristics," Accessed August 18, 2015. Available at: http://extension.psu.edu/animals/dairy/nutrient-management/certified-dairy/tools/manure-prod-char-d384-2.pdf

[15] Delaware Poultry Industry, Inc., Annual Industry Summaries. Accessed 8/13/2015, available at: https://www.dpichicken.org/faq_facts/docs/Delmarva%20Chicken%20Production%20Facts%201969-2014.pdf

[16] *Id.*

[17] Based on an the average house capacity calculated using data available from the Delmarva Poultry Industry, Inc. Delaware Poultry Industry, Inc., Annual Industry Summaries. Accessed 8/13/2015, available at: https://www.dpichicken.org/faq_facts/docs/Delmarva%20Chicken%20Production%20Facts%201969-2014.pdf

[18] Based on the average number of flocks that Maryland poultry farmers reported raising in 2013.

[19] Tremblay, Kristen and Rich Morrison, County of Accomack Planning Report, "Poultry Houses in Accomack County" July 29, 2015. Available at: http://www.boarddocs.com/va/coa/Board.nsf/files/9ZCTUH791015/$file/2015.08.05%20BOS%20Poultry%20Report%20PACKET.pdf

[20] *Id.*

[21] Tremblay, Kristen and Rich Morrison, County of Accomack Planning Report, "Poultry Houses in Accomack County" July 29, 2015. Available at: http://www.boarddocs.com/va/coa/Board.nsf/files/9ZCTUH791015/$file/2015.08.05%20BOS%20Poultry%20Report%20PACKET.pdf. The approximate number of additional chickens raised per year was calculated by assuming 27,000 chickens per poultry house and five flocks per year.

[22] U.S. Department of Agriculture, National Agricultural Statistics Service, Poultry Production and Value. Data available from: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1130 and accessed on 9/1/2015.

[23] Email correspondences with the Maryland Department of Natural Resources, August 21, 2015, corrected on September 21, 2015; a Public Information Act response from DNR; and Maryland Department of Natural Resources (May 31, 2015) Quality Assurance Project Plan for the Maryland Department of Natural Resourced Chesapeake Bay Water Quality Monitoring Program- Chemical and Physical Properties Component for the period July 1, 2015-June 30, 2016, pg. 5. Available at: http://mddnr.chesapeakebay.net/eyesonthebay/documents/MdDNR_MTQAPP2015.pdf; accessed on August 18, 2015.

[24] Environmental Integrity Project (July 2014) "Poultry's Phosphorus Problem", available at: http://environmentalintegrity.org/wp-content/uploads/Poultrys-Phosphorus-Problem.pdf.

[25] Maryland Department of the Environment, Biological Stressor Identification Studies (2012-2014), available from: http://www.mde.state.md.us/programs/Water/TMDL/Pages/Programs/WaterPrograms/tmdl/bsid_studies.aspx

[26] Maryland Department of Natural Resources (May 31, 2006) *Quality Assurance Project Plan for the Maryland Department of Natural Resourced Chesapeake Bay Water Quality Monitoring Program- Chemical and Physical Properties Component for the period July 1, 2006-June 30, 2007*, pg. 5. Accessed August 18, 2015. Available at: http://mddnr.chesapeakebay.net/eyesonthebay/documents/MTQAPP06.pdf. See also, Chesapeake Bay Program Water Quality Database (1984-present), available at http://data.chesapeakebay.net/WaterQuality.

[27] Staver, Kenneth W. and Russell B. Brinsfield (2001) "Agriculture and Water Quality on the Maryland Eastern Shore: Where Do We Go from Here?" *BioScience*. 51:10. Pp. 859-868. Available at: http://bioscience.oxfordjournals.org/content/51/10/859.full;

[28] Email correspondence with Maryland Department of Natural Resources, August 21, 2015.

[29] Annual implementation reports submitted by concentrated animal feeding operations (CAFOs) and Maryland animal feeding operations (MAFOs) are also sent to the Maryland Department of the Environment (MDE), which oversees water discharge permits for those operations. The Environmental Integrity Project requested the 2013 annual implementation reports from all regulated animal feeding operations from the MDE. CAFOs are required to report more information than MAFOs.

[30] These operations submitted notices of intent to be covered by the state's general discharge permit before or during 2013, according to MDE's animal feeding operation status database as of August 10, 2015. MDE also provided EIP with 40 annual implementation reports for operations that were not listed in MDE's database as of August 10, 2015. According to email correspondences with MDE, MDE's public database may not contain records for all poultry operations that were operating in 2013.

[31] Based on flock sizes contained in MDE's AFO status database and the average number of flocks raised by poultry operations that submitted AIRs in 2013. See the methods section for more information.

[32] COMAR 15.20.05.05 Cost-Share Program- Commercial Poultry Producer Participation. http://www.dsd.state.md.us/comar/comarhtml/15/15.20.05.05.htm

[33] Maryland Department of Agriculture (2014) "2014 Progress Report, Implementing Nutrient Management Programs, A Report to Governor O'Malley and the Maryland General Assembly by the Nutrient Management Advisory Committee, July 1, 2014" accessed August 17, 2015. Available at: http://dlslibrary.state.md.us/publications/Exec/MDA/AG8-804(a)(2)_2014.pdf See also: 2013 Progress Report: http://dlslibrary.state.md.us/publications/Exec/MDA/AG8-804(a)(2)_2013.pdf

[34]Senate Bill 0127, http://mgaleg.maryland.gov/2014RS/bills/sb/sb0127E.pdf; COMAR 15.20.05, http://www.dsd.state.md.us/comar/SubtitleSearch.aspx?search=15.20.05.* ; *see also:* "Maryland Farm Bureau Hotline: Legislative proposals that impact Maryland's Farm Community," April 16, 2014. Available at: http://agresearch.umd.edu/sites/default/files/_docs/Colby%20Ferguson%202014WMLGE.pdf

[35] Delmarva Poultry Industry, Inc., Facts About Maryland's Meat Chicken Industry, 2013. Available at: https://www.dpichicken.org/faq_facts/docs/factsmd2013.pdf accessed 9/1/2015

[36] According to integrators reported by 498 poultry operations on their 2013 annual implementation reports.

[37] Maryland Nutrient Management Manual, Accessed July 10, 2015. Available at: http://mda.maryland.gov/resource_conservation/Pages/nm_manual.aspx

[38] Based on a comparison between 2012 and 2013 annual implementation reports.

[39] According to crop recommendations based on soil tests and target crop yields outlined in the Maryland Nutrient Management Manual.

[40] Maryland Department of Agriculture (2015) "Maryland's Manure Transport Program," Accessed August 17, 2015. Available at: http://mda.maryland.gov/resource_conservation/Documents/MDAtransportrepr305-2.pdf

[41] COMAR 15.20.07.06 http://www.dsd.state.md.us/comar/comarhtml/15/15.20.07.06.htm

[42] Based on export addresses and the total amount of exported solid manure reported by poultry operations.

[43] Based on export addresses and the total amount of exported solid manure reported by poultry operations. See methods for more information.

[44] Maryland Nutrient Management Manual (2006) "Converting Among Soil Test Analyses Frequently Used in Maryland." Accessed August 17, 2015. Available at: http://mda.maryland.gov/resource_conservation/Documents/consultant_information/2006%20II-B%20p1-4%20s5.pdf

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