ASSATEAGUE COASTAL TRUST,	*	IN THE COURT OF APPEALS
Petitioner,	*	OF MARYLAND
v.	*	September Term, 2022
MARYLAND DEPARTMENT	*	No. ________
OF THE ENVIRONMENT,	*	
Respondent.	*	

*   *   *   *   *   *   *   *   *   *   *   *   *

PETITION FOR A WRIT OF CERTIORARI

Petitioner, Assateague Coastal Trust, by and through its undersigned counsel, files this petition for a *writ of certiorari* pursuant to Maryland Rules 8-302 and 8-303, and Md. Code Ann., Cts. & Jud. Proc. §12-205.

I. INTRODUCTION

This case presents novel issues of significant public interest with respect to (i) whether the Maryland Department of the Environment ("MDE") erred in issuing a General Discharge Permit for Animal Feeding Operations without including controls for ammonia emissions, when Maryland water pollution control laws unambiguously require regulation of ammonia emissions; and (ii) whether the Clean Water Act and the more stringent Maryland Water Pollution Control laws require discharge limitations that take into account impaired receiving waters (i.e. water quality-based effluent limitations) where effluent limitations based solely on minimum levels of treatment achieved by technology are ineffective. Certiorari is merited because MDE has failed to regulate more than 20 million pounds of ammonia emitted annually by Eastern Shore animal feeding operations. This amount of ammonia is more than twice the amount of nitrogen discharged to the Bay from all municipal sewage treatment plants combined. The undisputed record demonstrates that a large portion of these emissions fall onto rivers that feed directly into the already-impaired Chesapeake Bay or onto the Bay itself. Ammonia is a form of nitrogen, one of the three pollutants targeted by the federally-driven Bay restoration effort because it creates the aquatic dead zones that have choked life out of the Bay for decades. A decision by this Court regarding a critical statewide regulatory scheme would therefore provide protection for Maryland waters and the Chesapeake and Atlantic Coastal Bays.

II. THE PROCEEDING BELOW

The case below, *In the Matter of: Land and Materials Administration Determination to Re-Issue General Discharge Permit for Animal Feeding Operations State Discharge Permit #19AF/NPDES#MDGO1*, Case No. 482915-V, in the Circuit Court for Montgomery County (March 11, 2021) (Burrell, J.), involved a challenge to the General Discharge Permit for Animal Feeding Operations ("the Permit"). On September 4, 2019, MDE made a tentative determination to reissue its General Discharge Permit for AFOs. Exhaustive public participation and comments included extensive discussions about deficiencies and omissions in the Permit, including, inter alia, accounting for and controlling ammonia, compliance with water quality standards and impaired waters requirements, siting issues, and others. On June 2, 2020, the final version of the Permit was issued by MDE with minor revisions. On July 21, 2020, Assateague Coastal Trust timely filed its Petition for Judicial Review. The Circuit Court for Montgomery County adjudicated all claims in ruling for Petitioner, and held that Maryland water pollution control laws required the Permit to regulate ammonia emissions and also to implement water quality-based effluent limitations that took into account the impairment of the receiving water (March 11, 2021). MDE filed an appeal of the Circuit Court's ruling in the Court of Special Appeals (April 12, 2021) (CSA-REG-0209-2021, *Department of the Environment v. Assateague Coastal Trust*). The docket entry evincing the Petition for Judicial Review, the judgment of the Circuit Court, and MDE's notice of appeal is attached as Appendix 1. The Circuit Court's Memorandum Opinion and Order is attached as Appendix 2. MDE also filed a Motion to Stay the Circuit Court's ruling pending appeal, which was granted (July 12, 2021). The court's order granting the stay allowed MDE to continue registering operations under the invalidated Permit, industry-wide.[1]

The Court of Special Appeals issued an order for the parties to enter into Alternative Dispute Resolution, and staying the appeal, pursuant to 8-206(a) and 17-404(b) (June 11, 2021). Following several months of mediated settlement efforts with no resolution, the Court of Special Appeals issued a concurrent Order lifting the stay of the appeal and also ordering a fourth mediation session for March 3, 2022. Following the March 3rd mediation session, the matter has not been resolved by the Court of Special Appeals as of this Petition and MDE submitted its opening brief on March 30, 2022.

[1] MDE filed its notice of appeal to the Court of Special Appeals on April 12, 2022. Subsequently, on June 10, MDE filed a motion for stay pending appeal of the Circuit Court's March 11, 2021 Order. On July 12, 2022, that motion for stay was granted, which has allowed MDE to continue renewing permits and registering new AFOs during the appeals process. This stay continues notwithstanding the jurisdictional question of whether the Montgomery County Circuit Court maintained jurisdiction to rule on MDE's motion because the motion for stay was filed 59 days *after* filing its notice of appeal.

Petitioner's brief is due April 29, 2022. The Appellant MDE brief to the Court of Special Appeals is attached as Appendix 3.

III. QUESTIONS PRESENTED FOR REVIEW

1. Whether the Maryland Department of the Environment ("MDE") erred in issuing a General Discharge Permit for Animal Feeding Operations without including controls for ammonia emissions, when Maryland water pollution control laws unambiguously require regulation of ammonia emissions?

2. Whether the Clean Water Act and the more stringent Maryland Water Pollution Control laws require water discharge limitations that take into account impaired receiving waters (i.e. water quality-based effluent limitations) where effluent limitations based solely on minimum levels of treatment achieved by technology are ineffective?

IV. PERTINENT STATUTES AND REGULATIONS

1. Md. Code Ann., Envir. § 9-101.
2. Md. Code Ann., Envir. § 9-302, § 9-322, § 9-323, § 9-324.
3. Code of Maryland Regulations 26.08.01.01, 26.08.02.03, 26.08.03.01, 26.08.04.01, 26.08.04.07.

V. REVIEW IS DESIRABLE AND IN THE PUBLIC INTEREST

Review of these issues by the Court of Appeals is desirable and in the public interest to ensure compliance with water quality standards and control the more than 20 million pounds of ammonia emissions by Maryland's animal feeding operations each year. Under Maryland law, a discharge is defined as "[t]he addition, introduction, leaking, spilling, or *emitting* of a pollutant into the waters of this State; or … [t]he placing of a pollutant in a location where the pollutant is likely to pollute." Md. Code Ann. Envir. § 9-101(b) (emphasis added). A "pollutant" is defined as "[a]ny waste or wastewater that is discharged from … [a]n industrial source; or [a]ny other liquid, *gaseous*, solid, or other substance that will pollute any waters of this State." Md. Code Ann. Envir. § 9-101(g) (emphasis added). This definition is extraordinarily broad and would include ammonia emissions, which is a well-recognized gaseous water pollutant under state and federal law. 33 U.S.C. § 1311(g); COMAR 26.08.02.03-2.

The pollution stream from the poultry industry's more than 550 animal feeding operations, regulated solely by this statewide general permit, impacts large swaths of the state. Those impacts are dramatic and include enormous loadings of nutrients to Maryland waters and the Chesapeake and Atlantic Coastal bays regularly resulting in algal blooms and dead zones (App. 4 at 16-18; see App. 4 at 70-72.) This occurs in violation of Maryland's water pollution control laws which expressly regulate "gaseous" waste "emitted" from these operations when those emissions impact surface waters.[2] Md. Code Ann. Envir. § 9-101(g). Where such regulation is required of facilities discharging to already impaired waters, the Clean Water Act requires water quality-based effluent limitations. 33. U.S.C. § 1311(b)(1)(C). Absent resolution of these questions of regulation and its extent by the Court, the regulated industry will continue to pollute Maryland

[2] While Maryland's Water Pollution Control laws explicitly include gaseous emissions that reach surface or groundwater as pollutants that discharge, other states and the U.S. Environmental Protection Agency (EPA) do not uniformly address whether such emissions resulting in a discharge must be controlled by a discharge permit (Rose Acre Farms Inc. v. N.C. Dep't of Env't & Natural Res., No. 12-CVS-10, 2013 WL 459353 (N.C. Super. Ct. Jan. 4, 2013); Peconic Baykeeper, Inc. v. Suffolk Cty., 600 F.3d 180, 188-89 (2d Cir. 2010); Lois Alt v. United States EPA, 979 F. Supp. 2d 701, 709 (N.D.W. Va. 2013)).

waters, including the Chesapeake and Atlantic Coastal bays, affecting residents across the state and regional economies.

VI. STATEMENT OF FACTS IN SUPPORT OF PETITION

A. Overview of Nitrogen Pollution from Poultry Animal Feeding Operations in Maryland

As described above, poultry production represents the vast majority of the animal feeding operations ("AFOs") in Maryland. The more than 500 poultry AFOs on the Eastern Shore produce over 300 million birds ("broilers") every year. (App. 4 at 16-18; see App. 4 at 70-72.) The typical poultry AFO produces over 500,000 broilers annually. *Id.* Each year the average broiler weight goes up, increasing 12 percent over the past decade to six pounds each. *Id.* With these immense production numbers comes waste, hundreds of millions of pounds of it. In 2017, poultry broiler production in Maryland generated approximately 440 million pounds of manure. *Id.*

One of the largest contributions of nitrogen pollution to the Bay and its tributaries on the Eastern Shore is nitrogen in the form of ammonia emitted from animal waste. (App. 4 at 21.) Ammonia is emitted from poultry waste via a process called volatilization, whereby ammonia changes composition and converts to a gas emitted by manure inside poultry houses and manure storage sheds. Everyone has experienced the smell of manure caused by these gases. The ammonia-nitrogen emitted moves through the air and deposits onto the surrounding acreages and surface water. *Id.* (see 40 C.F.R. § 122.23(b)(8)). Emissions rates from broiler operations have been studied for decades. (App. 4 at 16-18; see App. 4 at 50; see App. 4 at 69.) Ammonia emissions estimates are derived from a range of studies, both by university agricultural extensions and by EPA. *Id.* Modelling of ammonia emissions from poultry AFOs on the Eastern Shore alone yields well over 10,000 tons, or 20 million pounds of ammonia emitted, each year. (App. 4 at 18; see App. 4 at 24, 39; App. 4 at 70.) At issue here is the fate of those millions of pounds of ammonia-nitrogen, a majority of which deposits onto the lands and waters of the Eastern Shore and the Chesapeake and Atlantic Coastal bays. *Id.*

At least 18 percent, and up to 40 percent, of ammonia is deposited within 1.5 miles of a poultry house and up to 70 percent is deposited within 30 miles of the AFO. *Id.* The amount of ammonia deposition is greatest closest to the source. Even based on the most conservative estimates, lands, wetlands and waters nearest the poultry house are blanketed with at least five pounds of ammonia on average, every year. *Id.*; see 40 C.F.R. § 122.23(b)(4)). As far out as a quarter-mile from a poultry AFO, ammonia deposits onto every acre of land and/or water at a rate of at least one pound per year.

Collectively, the more than 500 poultry AFOs on Maryland's Eastern Shore *deposit* over 7,000 tons, or 14 million pounds, of ammonia-nitrogen directly onto the Eastern Shore. *Id.* Of that total, more than 1,000 tons, or 2 million pounds, falls directly onto the 285,297 acres of freshwater and estuarine tributaries and wetlands on Maryland's Eastern Shore. *Id.* Finally, the Chesapeake Bay Watershed Model operated by the federal-state Chesapeake Bay Program estimates that millions of pounds of that nitrogen are transported via waters of the State into the Chesapeake Bay, with an additional 400 tons, or 800,000 pounds of ammonia from AFOs directly depositing onto the Bay itself. (App. 4 at 8, 18; App. at 46.) The immensities of these loadings are difficult to put in perspective. For comparison, all municipal sewage treatment plants in Maryland combined sent about 8.4 million pounds of nitrogen to the Bay in 2019, according to the Chesapeake Bay Program website.

B. Regulation of Animal Feeding Operations in Maryland and Legal Framework

As discussed above, Maryland's Water Pollution Control laws define a "discharge" much more broadly than the federal Clean Water Act and are more stringent than federal law, as evidenced by express statutory intent language and the "additional and cumulative" protections in Title 9 of the Environment Article and layered on top of the federal floor established by the Clean Water Act. Md. Code Ann. Envir. § 9-302(a). In addition to qualifying as a "pollutant" by virtue of being a "gaseous … substance," ammonia is also a "waste" from an "industrial source". COMAR 26.08.01.01. "Waste" is defined in Maryland regulations as "industrial waste and all other liquid, *gaseous*, solid, or other substances which will pollute any waters of this State," and "industrial waste" is defined as "any liquid, *gaseous*, solid, or other waste substance, or combination thereof, resulting from ... [a]ny process of industry, manufacturing, trade or business; or … [t]he development of any natural resource, including agriculture." *Id.* (emphasis added). Moreover, it should be noted that the State has specifically established water quality criteria for ammonia. COMAR 26.08.02.03-2. These include criteria for ammonia toxicity at both chronic and acute levels, in both freshwater and estuarine water segments. *Id.*

Because Maryland's definition of "Waters of the State" is substantially broader than the federal definition of "Waters of the United States," which covers only some subset of surface waters, and neither groundwater nor flood plains, a much greater quantity of pollutants emitted from an AFO will inevitably reach a Water of the State under state jurisdiction than a Water of the United States under federal jurisdiction by depositing into numerous small streams, ponds, wetlands, and other surface waters not subject to federal regulation, as well as into certain floodplains and infiltrating to ground waters. Md. Code Ann. Envir. § 9-101(l).

VII. REASONS FOR GRANTING REVIEW

Review by this Court is warranted and in the public interest because it will have enormous implications for human health, the environment, and the regional economy. As stated above, the regulatory and statutory schemes require regulation of ammonia emissions and deposition from the poultry industry. The Circuit Court found that Maryland law requires regulation of this enormous pollution stream, via the statewide permitting scheme.

A. Certiorari should be granted to determine that a Maryland Water Pollution Control General Discharge Permit requires regulation of gaseous emissions in the form of ammonia.

As described above, state law defines gaseous ammonia emissions as a discharge of a pollutant. In sum, Maryland's Water Pollution Control laws and regulations, which define for key terms "discharge," "pollutant," "waste," "industrial waste," and "Waters of the State," leave no doubt that ammonia is a source of water pollution subject to the State's discharge permitting requirements.

Because ammonia, after discharge, deposits on waters and watersheds as a form of the pollutant nitrogen, it has been recognized by the Chesapeake Bay Program as a major contributor of nitrogen pollution to Maryland's extensive list of nitrogen-impaired waters, including, most notably, the Chesapeake Bay, but also major tributaries to the Bay. A discharge may only be permitted if the "discharge does not contravene the surface water quality standards." COMAR 26.08.03.01C. Thus, MDE is required to ensure that ammonia does not contravene water quality standards by causing or contributing to the impairment of waters of the State for either ammonia or nitrogen.

Despite these clear and explicit statutory and regulatory requirements, MDE reissued the AFO general permit without any limitations on ammonia, or even any discussion of this major source of pollution.

B. Certiorari should be granted to determine that a Clean Water Act permit requires water quality-based effluent limitations where technology-based effluent limitations are insufficient.

Every Clean Water Act discharge permit must ensure that discharges comply with all applicable water quality standards applicable to the receiving water. 33 U.S.C. § 1342(a)(1); Md. Code Ann. Envir. § 9-324. A discharge is unlawful unless it includes "limitations … necessary to meet water quality standards." 33. U.S.C. § 1311(b)(1)(C). "No permit may be issued when the imposition of conditions cannot ensure compliance with the applicable water quality requirements of all affected States." 40 C.F.R. § 122.4(d) (internal punctuation omitted).

MDE has authority to issue a discharge permit if the Department finds that the discharge meets … [a]ll applicable State and federal water quality standards." Md. Code

Ann., Envir. § 9-324; see also COMAR 26.08.04.01A. A discharge may only be permitted if "the discharge does not contravene the surface water quality standards established by this state." COMAR 26.08.03.01C(1). If best available technology is determined to be insufficient to achieve "compliance with the established water quality standards," MDE regulations specify that "additional treatment shall be (i) [r]equired; and (ii) [b]ased on waste load allocation." COMAR 26.08.03.01C(2). Thus, under both state and federal law, where required technology-based effluent limitations are insufficient to achieve the applicable water quality standard, the Permit must include any more stringent permit requirements necessary to achieve those standards. *Cty. Comm'rs of Carroll Cty.*, 465 Md. at 186.

This Court recently examined a discharge permit with a water quality-based effluent limitation written by MDE, and emphasized the importance of such permit requirements to maintain consistency between discharge permits and water quality standards, including Clean Water Act water restoration plans known as Total Maximum Daily Loads ("TMDLs"), even where such limitations are in narrative form and not strictly numeric reflections of the waste load allocations within a TMDL. *Id.* at 222.

Despite the clear requirement in state and federal law to include a water quality-based effluent limitation, and the compelling need to do so in light of the impairment of Chesapeake Bay and its restoration effort, the Permit at issue here fails to include any such limitation. Instead, the Permit merely authorizes, but does not require, MDE to impose "additional [management practices] and controls" based on "the assumptions and requirements of the Chesapeake Bay TMDL" or "additional or alternative controls or monitoring" based on additional TMDLs. *Id.* MDE is interpreting its role with respect to the incorporation of water quality-based effluent limitations into discharge permits not as the mandate that it is, but as a discretionary exercise. This approach fails to comply with the Maryland and federal law cited above requiring that the permit must include limitations on discharges which will ensure compliance with applicable water quality standards and TMDLs.

CONCLUSION

This petition presents an issue of public importance and review by this Court is desirable and in the public interest. The Assateague Coastal Trust respectfully requests that this Honorable Court grant this petition for writ of certiorari.

[SIGNATURES ON FOLLOWING PAGE]

Respectfully submitted,

/s/ David L. Reed

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CERTIFICATION OF WORD COUNT AND COMPLIANCE WITH RULE 8-303

1. This brief contains 2,915 words, excluding the parts of the brief exempted from the word count by Rule 8-303(b).

2. This brief complies with the font, spacing, and type size requirements stated in Rule 8-112.

<u>CERTIFICATE OF SERVICE</u>

I hereby certify that on this 11th day of April, 2022, a copy of the foregoing **Petition for a Writ of Certiorari** was electronically filed with the Clerk of the Court and also sent via electronic mail to:

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Counsel for Appellant, Maryland Department of the Environment

<u>/s/ David L. Reed</u>
David L. Reed

APPENDIX 1

Montgomery County Circuit Court Docket as of April 8, 2022

Case Information

Court System: **Circuit Court For Montgomery County - Civil**
Location: **Montgomery Circuit Court**
Case Number: **482915V**
Title: **In the Matter of ASSATEAGUE COASTAL TRUST**
Case Type: **Appeal - Administrative Agency**
Filing Date: **07/23/2020**
Case Status: **Reopened / Inactive**

Other Reference Numbers

Case Appealed **CSA-REG-0209-2021**

Involved Parties Information

Other Party

Name: **MARYLAND DEPARTMENT OF THE ENVIRONMENT**
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City: **BALTIMORE** State: **MD** Zip Code: **21230**

Attorney(s) for the Other Party

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Petitioner

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City: **BERLIN** State: **MD** Zip Code: **21811**

Attorney(s) for the Petitioner

Name: **ISAACSON, EVAN MICHAEL**
Appearance Date: **07/28/2020**
Removal Date: **04/21/2021**

Name: **Brubach, Hannah Kathleen**
Appearance Date: **08/18/2020**
Removal Date: **04/21/2021**

Name: **REED, DAVID L**
Appearance Date: **12/03/2020**
Removal Date: **04/21/2021**
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Name: **REED, DAVID L**
Appearance Date: **06/24/2021**
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Respondent

Name: **LAND AND MATERIALS ADMINISTRATION**
Address: **DETERMINATION TO RE-ISSUE PERMIT GENERAL DISCHARGE PERMIT FOR ANIMAL FEEDING**
City: State:

Court Scheduling Information

Event Type	Event Date	Event Time	Court Location	Court Room	Result
Hearing	01/26/2021	14:30:00	Conversion - Montgomery Circuit Court		Concluded / Held

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Judgment Information

Judgment Event Type: **Converted Judgment Event Type**

Document Information

File Date: **07/23/2020**
Filed By:
Document Name: **Petition**
Comment: **Type: Docket; Code: 409; Filed by: P Plaintiff; Text: PLAINTIFF'S PETITION FOR JUDICIAL REVIEW, FILED.; User Name: CAREYS**

File Date: **07/23/2020**
Filed By:
Document **Information Sheet Filed**

Name:

Comment: Type: Docket; Code: 114; Filed by: P Plaintiff; Text: PLAINTIFF'S INFORMATION SHEET, FILED.; User Name: CAREYS

File Date: **07/28/2020**

Filed By:

Document Name: **Notice of Filing Record**

Comment: **Type: Docket; Code: 836; Filed by: C Court; Text: NOTICE SENT GIVING NEW CASE NUMBER TO ALL PARTIES.; User Name: CAREYS**

File Date: **07/28/2020**

Filed By:

Document Name: **Copies Mailed**

Comment: **Type: Docket; Code: 1013; Filed by: C Court; Text: COPY OF PETITION FOR JUDICIAL REVIEW MAILED RETURN RECEIPT REQUESTED TO MARYLAND DEPARTMENT OF THE ENVIRONMENT.; User Name: CAREYS**

File Date: **08/14/2020**

Filed By:

Document Name: **Answer**

Comment: **Type: Docket; Code: 705; Filed by: O Other; Text: MARYLAND DEPARTMENT OF THE ENVIRONMENT'S RESPONSE TO PETITION FOR JUDICIAL REVIEW, FILED. (LP); User Name: HUNGERA2**

File Date: **08/17/2020**

Filed By:

Document Name: **Attorney Appearance - No Fee**

Comment: **Type: Docket; Code: 609; Filed by: P Plaintiff; Text: LINE ENTERING THE APPEARANCE OF HANNAH BRUBACH AS COUNSEL FOR PLAINTIFF, FILED. (LP); User Name: CRYSTALT**

File Date: **08/20/2020**

Filed By:

Document Name: **Motion / Request - For Special Admission of Attorney**

Comment: **Type: Motion; Code: 37; Status: Granted; Filed by: P Plaintiff; Text: EVAN M. ISAACSON'S MOTION FOR SPECIAL ADMISSION OF DAVID L. REED OUT-OF-STATE ATTORNEY UNDER RULE 19-217 GOVERNING ADMISSION TO THE BAR OF MARYLAND AS CO-COUNSEL FOR THE PLAINTIFF, FILED. (LP); User Name: PASTORAW**

File Date: **09/28/2020**

Filed By:

Document Name: **Transcript Received**

Comment: **Type: Docket; Code: 78; Filed by: O Other; Text: COPY OF RECORD RECEIVED MARYLAND DEPARTMENT OF THE ENVIRONMENTS ADMINISTRATIVE RECORD, FILED. (MDE 19AF - 00001 - MDE 19AF -000310 IN JACKET #1, MDE 19AF - 000311 - MDE 19AF - 000665 IN JACKET #2, MDE 19AF - 000666 - MDE 19AF -001000 IN JACKET #3, MDE 19AF - 001001 - MDE 19AF - 001351 IN JACKET #4, MDE 19AF - 001352 - MDE 19AF - 001678 IN JACKET #5, MDE 19AF - 001679 - MDE 19AF - 002000 IN JACKET #6, MDE 19AF - 002001 - MDE 19AF - 002349 IN JACKET #7, MDE 19AF - 002350 - MDE 19AF - 002699 IN JACKET #8, MDE 19AF - 002700 - MDE 19AF - 003000 IN JACKET #9, MDE 19AF - 003001 - MDE 19AF - 003373 IN JACKET #10); User Name: PASTORAW**

File Date: **09/28/2020**

Filed By:

Document Name: **Notice of Filing Record**

Comment: **Type: Docket; Code: 436; Filed by: C Court; Text: NOTICE UNDER MARYLAND RULE 7-206(E) MAILED TO ALL PARTIES. (LP); User Name: PASTORAW**

File Date: **09/28/2020**
Filed By:
Document Name: **Supporting Exhibit**
Comment: **TRANSCRIPT RECEIVED MDE19AF-00001 - MDE 19AF-000310 (#1 of 10)**

File Date: **09/28/2020**
Filed By:
Document Name: **Supporting Exhibit**
Comment: **TRANSCRIPT RECEIVED MDE 19AF-000311 - MDE 19AF-000665 (#2 OF 10)**

File Date: **09/28/2020**
Filed By:
Document Name: **Supporting Exhibit**
Comment: **TRANSCRIPT RECEIVED MDE 19AF-000666 - MDE 19AF-001000 (#3 OF 10)**

File Date: **09/28/2020**
Filed By:
Document Name: **Supporting Exhibit**
Comment: **TRANSCRIPT RECEIVED MDE 19AF-001001 - MDE 19AF - 001351 (#4 OF 10)**

File Date: **09/28/2020**
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Document Name: **Supporting Exhibit**
Comment: **TRANSCRIPT RECEIVED MDE 19AF-001352 - MDE 19AF-001678 (#5 OF 10)**

File Date: **09/28/2020**
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Document Name: **Supporting Exhibit**
Comment: **TRANSCRIPT RECEIVED MDE 19AF-001679 - MDE 19AF-002000 (#6 OF 10)**

File Date: **09/28/2020**
Filed By:
Document Name: **Supporting Exhibit**
Comment: **TRANSCRIPT RECEIVED MDE 19AF-002001 - MDE 19AF-002349 (#7 OF 10)**

File Date: **09/28/2020**
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Document Name: **Supporting Exhibit**
Comment: **TRANSCRIPT RECEIVED MDE 19AF-002350 - MDE 19AF-002699 (#8 of 10)**

File Date: **09/28/2020**
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Document Name: **Supporting Exhibit**
Comment: **TRANSCRIPT RECEIVED MDE 19AF-002700 - MDE 19AF-003000 (#9 OF 10)**

File Date: **09/28/2020**
Filed By:
Document Name: **Supporting Exhibit**
Comment: **TRANSCRIPT RECEIVED MDE 19AF-003001 - MDE 19AF-003373 (#10 OF 10)**

File Date: **10/27/2020**
Filed By:
Document Name: **Memorandum**
Comment: **Type: Docket; Code: 727; Filed by: P Plaintiff; Text: PLAINTIFF'S MEMORANDUM IN SUPPORT OF PETITION FOR JUDICIAL REVIEW AND ATTACHMENTS, FILED. (LP); User Name: PASTORAW**

File Date: **11/30/2020**
Filed By:

Document Name: **Memorandum**

Comment: **Type: Docket; Code: 727; Filed by: O Other; Text: STATE OF MARYLAND, DEPARTMENT OF THE ENVIRONMENT'S ANSWERING MEMORANDUM, FILED. (LP); User Name: PASTORAW**

File Date: **12/03/2020**

Filed By:

Document Name: **Order**

Comment: **Type: Ruling; Code: 457; Status: Granted; Filed by: C Court; Text: ORDER OF COURT (BURRELL, J.) THAT DAVID L. REED IS ADMITTED SPECIALLY FOR THE LIMITED PURPOSE OF APPEARING AND PARTICIPATING IN THIS CASE AS CO-COUNSEL FOR ASSATEAGUE COASTAL TRUST. THE PRESENCE OF THE MARYLAND LAWYER IS WAIVED, ENTERED. (COPIES MALED); User Name: PASTORAW**

File Date: **12/07/2020**

Filed By:

Document Name: **Notice of Hearing / Trial - Issued**

Comment: **Type: Docket; Code: 437; Filed by: C Court; Text: NOTICE OF HEARING DATE FILED AND MAILED. (HEARING DATE: 01/26/2021) (LP); User Name: PASTORAW**

File Date: **12/07/2020**

Filed By:

Document Name: **Memorandum**

Comment: **Type: Docket; Code: 727; Filed by: C Court; Text: JUDGE BURRELL'S MEMORANDUM TO THE ASSIGNMENT COMMISSIONER, FILED. (LP); User Name: PASTORAW**

File Date: **12/11/2020**

Filed By:

Document Name: **Response/Reply**

Comment: **Type: Docket; Code: 522; Filed by: P Plaintiff; Text: PLAINTIFF'S REPLY BRIEF OF ASSATEAGUE COASTAL TRUST, FILED. (FILED BY EMAIL) (LP); User Name: WILLIAML**

File Date: **12/22/2020**

Filed By:

Document Name: **Certificate of Service**

Comment: **Type: Docket; Code: 446; Filed by: O Other; Text: STATE OF MARYLAND, DEPARTMENT OF THE ENVIRONMENT'S AMENDED CERTIFICATE OF SERVICE AND ATTACHMENT, FILED. (FILED BY EMAIL) (LP); User Name: PASTORAW**

File Date: **01/26/2021**

Filed By:

Document Name: **Court Proceeding**

Comment: **Type: Docket; Code: 1514; Filed by: C Court; Text: HEARING (BURRELL, J.) ON PETITIONER'S PETITION FOR JUDICIAL REVIEW (DE#1). PLAINTIFF'S COUNSEL APPEARED VIA VIDEO, MR. REED, MS. BRUBACH AND MR. ISAACSON. DEFENDANT'S COUNSEL APPEARED VIA VIDEO, MR. STANDEVEN.; Tape# 3F-210126 Start# 14:34:36 Stop# 15:36:48 Sessions 1 ; User Name: LAWREB01**

File Date: **01/26/2021**

Filed By:

Document Name: **Court Takes Under Advisement**

Comment: **Type: Docket; Code: 91; Filed by: C Court; Text: COURT (BURRELL, J.) TAKES MATTER UNDER ADVISEMENT.; User Name: LAWREB01**

File Date: **03/12/2021**

Filed By:

Document Name: **Opinion and Order of the Court**

Comment: **Type: Docket; Code: 1592; Filed by: C Court; Text: MEMORANDUM OPINION AND ORDER OF COURT (BURRELL, J.) THE MARYLAND DEPARTMENT OF THE ENVIRONMENT'S FINAL DETERMINATION IS REVERSED. THE PERMIT IS REMANDED TO THE MDE TO MANDATE EFFLUENT LIMITATIONS FOR AMMONIA AND OTHER WATER QUALITY BASED EFFLUENT LIMITATIONS, ENTERED. (COPIES MAILED); User Name: HUNGERA2**

File Date: **03/12/2021**

Filed By:

Document Name: **Order - Remand**

Comment: **Type: Docket; Code: 591; Filed by: C Court; Text: ORDER OF COURT (BURRELL, J.) THAT THE MARYLAND DEPARTMENT OF THE ENVIRONMENT'S FINAL DETERMINATION IS REVERSED; THAT MARYLAND PERMIT NO. 19AF/NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM PERMIT NO. MDG01 IS REMANDED TO THE MARYLAND DEPARTMENT OF THE ENVIRONMENT TO MANDATE EFFLUENT LIMITATIONS FOR AMMONIA AND OTHER WATER QUALITY BASED EFFLUENT LIMITATIONS, ENTERED. (COPIES MAILED) (STAYED PENDING APPEAL PER DE #26); User Name: HUNGERA2**

File Date: **04/12/2021**

Filed By:

Document Name: **Notice of Appeal to COSA**

Comment: **Type: Docket; Code: 823; Filed by: D Defendant; Text: DEFENDANT'S NOTICE OF APPEAL, FILED. (LP); User Name: GREGOA01**

File Date: **06/10/2021**

Filed By:

Document Name: **Motion / Request - To Stay**

Comment: **Type: Motion; Code: 232; Status: Granted; Filed by: O Other; Text: MARYLAND DEPARTMENT OF THE ENVIRONMENT'S MOTION FOR STAY PENDING APPEAL, FILED. (NO PROPOSED BLANK ORDER); User Name: PASTORAW**

File Date: **06/16/2021**

Filed By:

Document Name: **Order - Alternative Dispute Resolution (ADR)**

Comment: **Type: Docket; Code: 1678; Filed by: C Court; Text: ORDER OF COURT OF SPECIAL APPEALS (FADER, J.) FOR ALTERNATIVE DISPUTE RESOLUTION BEFORE A JUDGE-MEDIATOR AND THE ADR DIVISION DIRECTOR ON JULY 20, 2021 AT 12:00 P.M., ENTERED.; User Name: GREGOA01**

File Date: **06/16/2021**

Filed By:

Document Name: **Copies**

Comment: **Type: Docket; Code: 312; Filed by: C Court; Text: COPY OF DOCKET ENTRIES MAILED TO THE DIRECTOR OF ADR PROGRAMS.; User Name: GREGOA01**

File Date: **06/24/2021**

Filed By:

Document Name: **Opposition**

Comment: **Type: Opposition; Code: 900; Filed by: P Plaintiff; Text: PLAINTIFF'S RESPONSE TO THE MARYLAND DEPARTMENT OF ENVIRONMENT'S MOTION FOR STAY PENDING APPEAL, FILED. (FILED BY EMAIL) (LP); User Name: PASTORAW**

File Date: **07/13/2021**

Filed By:

Document Name: **Stay Action**

Comment: **Type: Ruling; Code: 653; Status: Granted; Filed by: C Court; Text: ORDER OF COURT (BURRELL, J.) THAT THE MARYLAND DEPARTMENT OF THE ENVIRONMENT'S MOTION TO STAY PENDING**

APPEAL IS GRANTE; AND THAT THIS COURT'S ORDER ENTERED MARCH 12, 2021 (D.E. 20) SHALL BE STAYED PENDING APPEAL, ENTERED. (COPIES MAILED); User Name: EVELYND

File Date: **12/20/2021**
Filed By:
Document Name: **Order - Alternative Dispute Resolution (ADR)**
Comment: **Order MODIFYING ADR Order - Ordered, on March 3, 2022 at 11:00 a.m. all counsel in the above-captioned case shall appear before a judge-mediator and the ADR Division Acting Director or her designee to participate in a conference call using the online platform, Zoom for Government, to discuss settlement proposals, entered.**

File Date: **12/20/2021**
Filed By:
Document Name: **Order to Proceed**
Comment: **Ordered that the stays imposed by this Court's June 11, 2021 Order to ADR, be, and are hereby lifted; and that the time within which a transcript must be ordered pursuant to MD Rule 8-411(b) and the record prepared and filed with this Court pursuant to MD Rule 8-412(a) shall begin to run from the date of this Order, and that all cousel must appear for the conference call, entered.**

File Date: **01/04/2022**
Filed By:
Document Name: **Transcript or Audio Recording Requested**
Comment: **MD Department of Environment**

File Date: **01/24/2022**
Filed By:
Document Name: **Transcript**
Comment: **Transcript of proceedings on Hearing on 01/26/2021, filed. $99.00 (Other)**

File Date: **02/18/2022**
Filed By:
Document Name: **Original Record Sent**
Comment:

APPENDIX 2

Montgomery County Circuit Court's Memorandum Opinion and Order

IN THE CIRCUIT COURT FOR MONTGOMERY COUNTY, MARYLAND

IN RE PETITION OF ASSATEAGUE COASTAL TRUST FOR JUDICIAL REVIEW OF THE DECISION OF: THE MARYLAND DEPARTMENT OF THE ENVIRONMENT IN THE MATTER OF: LAND AND MATERIALS ADMINISTRATION DETERMINATION TO RE-ISSUE GENERAL DISCHARGE PERMIT FOR ANIMAL FEEDING OPERATIONS STATE DISCHARGE PERMIT #19AF/ NPDES # MDG01	:	Case No.: 482915-V

MEMORANDUM OPINION

This matter came before the Court on January 26, 2021, on Petitioner Assateague Coastal Trust's administrative appeal of the Maryland Department of the Environment's ("MDE") reissuance of State Discharge Permit No. 19AF/National Pollution Discharge Elimination System Permit No. MDG01 ("the Permit"), which includes requirements for concentrated animal feeding operations ("CAFOs"). The Court has considered the record in this case, the memoranda filed by the parties, arguments of counsel, and applicable case law.

BACKGROUND

I. APPLICABLE LAW

A. The Clean Water Act

The Clean Water Act (the "CWA") prohibits the discharge of pollutants into waters of the United States by creating a federal-state partnership to regulate the introduction of pollution by point sources. 33 U.S.C. § 1251 *et. seq.* "Through the National Pollution Discharge Elimination System (the "NPDES"), 33 U.S.C. § 1342, either the Environmental Protection Agency (the

"EPA") or an EPA-approved state, such as Maryland, may issue permits exempting a discharger from this prohibition." *Anacostia Riverkeeper v. Md. Dep't of the Env't*, 447 Md. 88, 96 (2016). The EPA or an approved state can issue either individual permits, which regulate site specific locations at individual point sources, or general permits, which regulate multiple point sources operating similar facilities and producing similar waste. *See Texas Indep. Producers and Royalty Owners Assoc. et al. v. EPA*, 410 F.3d 964, 967–68 (7th Cir. 2005) (discussing the legislative progression establishing general permits for dumping). In Maryland, the MDE has been designated by the EPA to issue discharge permits that limit pollution introduced into the Chesapeake Bay (the "Bay"). *Anacostia Riverkeeper*, 447 Md. at 96.

Acquiring a permit does not enable a point source to dump pollutants indiscriminately. Rather, permits contain specific limitations that allow point sources to discharge a certain amount of pollutants, called effluent limitations, while also requiring best management practices to reduce the accidental introduction of any contaminants into the Bay. 33 U.S.C. § 1362(11). The effluent limitations outlined in a permit are determined by the Total Maximum Daily Load ("TMDL") which is the maximum amount of pollutants a body of water can receive before violating applicable water quality standards. 33 U.S.C. § 1313(d)(1)(c). The EPA has developed a specific TMDL for the Bay that imposes limitations on each Bay state's ability to pollute waters within the Bay's watershed. Each Bay state is charged with creating a Watershed Implementation Plan that "functions as a 'roadmap' for how and when [each] State will reach the pollution reduction goals set forth in the Bay TMDL." *Md. Dep't of the Env't v. Cty. Commissioners of Carroll Cty.*, 465 Md. 169, 195 (2019) (quoting *Anacostia Riverkeeper*, 447 Md. at 109).

B. Maryland's Expansion of the Clean Water Act

The CWA regulates concentrated animal feeding operations ("CAFOs") as point sources, and requires the owner/operator to obtain a National Pollutant Discharge Elimination System ("NPDES") permit. Admin. R. at 000269. The CWA enables and encourages states to build upon the CWA's framework to better protect waters within a state's borders. Maryland has used this authority to broaden the scope of protection afforded by the CWA and has charged the MDE "with managing, improving, controlling, and conserving the waters of Maryland." *Northwest Land Corp. v. Md. Dep't of Env't*, 104 Md. App. 471, 478 (1995); MD. CODE. ANN. ENVIR. § 9-322 *et. seq.*

The broad scope of Maryland's statutory scheme is exemplified by the expanded definitions of several terms that enlarge the MDE's mandate and enables the MDE to regulate multiple categories of pollutants. *Compare*, MD. CODE. ANN. ENVIR. § 9-101 (defining "discharge" as "the addition, introduction, leaking, spilling, or emitting of a pollutant into the waters of this State" and "pollutant" as "any other liquid, gaseous, solid, or other substance that will pollute any waters of this State"), *with* 33 U.S.C. § 1362 (failing to define the term discharge and enumerating specific categories of waste that are considered a pollutant). Further, Maryland has created an additional category of regulated livestock operations separate from CAFOs to ensure that all point sources in Maryland are subject to dumping restrictions. These operations, called Maryland Animal Feeding Operations ("MAFOs"), are nearly identical to CAFOs but include livestock businesses that are outside the purview of the CWA because they do not discharge storm water directly to surface waters of the State. COMAR 26.08.01.01.

II. RELEVANT FACTS

Maryland's Eastern Shore is home to a robust poultry industry that produces over 300 million broilers annually. Admin. R. at 000484–86 (letter from Chesapeake Legal Alliance).[1] These poultry operations often house well over 50,000 animals and are usually designated as either a CAFO or an MAFO. *Id.* The large size of these operations is paralleled by the amount of waste that they produce. For example, "in 2017, poultry broiler production in Maryland generated approximately 440 million pounds of manure." *Id.* at 000485. The manure also creates gaseous ammonia that is typically blown out of poultry houses by industrial fans only to settle on nearby land and waterways, causing significant pollution to the Bay. Petitioner's Memorandum at 2. The MDE regulated the discharge of waste from CAFOs into the Chesapeake Bay through the CWA and Maryland's related statutory regime through a General Discharge Permit for Animal Feeding Operations (GD Permit), Maryland Permit #19AF, NPDES Permit #MDG01 ("the Permit"). On September 4, 2019, the MDE made a tentative decision to reissue the Permit without limitations on the discharge of gaseous ammonia from CAFOs. Admin. R. at 000003–37 ("the Permit"). After release of the initial draft, the MDE held a public comment period in which Petitioner participated. In *Response to Public Comments Regarding General Discharge Permit for Animal Feeding Operations Maryland Discharge Permit No. 19AF, NPDES Permit No. MDG01 July 8, 2020*, the MDE set forth topics of broad public comment categories, followed by its response to each. Admin. R. 000268-285. In Section V, Monitoring, the public comments were summarized in pertinent part:

> **The Permit does not adequately address air pollution (particulate matter/ammonia depositions) from poultry house exhaust fans and manure sheds that are deposited in the air and make their way to surface waters**

[1] Petitioner is represented by Chesapeake Legal Alliance and most of the references to the record refer to the organization's submission made during the public comment period after release of the initial draft of the Permit.

> **causing health and water quality impairments. . . . The Permit must be amended to reflect air emissions and monitoring requirements based on results from studies to be conducted by December 1, 2021. . . . . How will MDE regulate these emissions in the Permit and determine impacts to resources? What is the monitoring strategy?**

Admin. R. 000277 (bold in original). MDE responded in pertinent part:

> EPA does not regulate odors or air quality through its CAFO permitting program. *See generally* 40 CFR 122.23. While MDE derives much of its NPDES permitting authority from EPA and the CWA, it is authorized, as a delegated program, to impose requirements that are more stringent than what is required by CWA or EPA's regulations. Therefore, MDE included in the draft General Discharge Permit provisions that require AFO owners or operators to implement BMPs [best management practices] in order to reduce nuisance odors and address any air quality resource concerns using appropriate NRCS Practice Standard(s). *See* General Discharge Permit at Part IV.D.1-2. . . . . Ammonia emissions/ammonia deposition have been considered and addressed to the extent permissible under the Clean Water Act and the state's water pollution control law and implementing regulations with the requirement of several NRCS practices including litter amendments and hedgerows/shelterbelts.

Id. at 000277-278.

The MDE issued the five-year Permit that became effective on July 3, 2020, and will expire on July 7, 2025. Admin. R. at 000003-37 (State Discharge Permit No. 19AF/National Pollution Discharge Elimination System Permit No. MDG01). The limitations contained within the Permit authorize CAFOs and MAFOs to discharge numerous pollutants into the bay in accordance with MDE's mandated limitations and the Bay's TMDL. On September 23, 2020, Petitioner appealed the MDE's final determination to reissue the Permit without gaseous ammonia prohibitions.

III. STANDARD OF REVIEW

Judicial review of discharge permits is provided for in MD. CODE. ANN. ENVIR. § 1-601(a)(3)(c). The review is limited to issues presented in the administrative record before the Department. §1-601(d). "In reviewing an agency's legal conclusions, it is a fundamental principle of administrative law that a reviewing court should not substitute its judgment for the expertise of those persons who constitute the administrative agency." *John A. v. Bd. of Educ. For Howard Cty.*, 400 Md. 363, 381–82 (2007). "A court's role [in an administrative appeal] is limited to determining if there is substantial evidence in the record as a whole to support the agency's findings and conclusions, and to determine if the administrative decision is premised upon an erroneous conclusion of law." *United Parcel v. People's Counsel*, 336 Md. 569, 577 (1994).

An agency's fact-based decision must be given great deference. "The substantial evidence and arbitrary and capricious standards apply where an 'organic statute' authorizes judicial review without a contested case hearing and does not set forth a standard of review." *Anacostia Riverkeeper*, 447 Md. at 118. Substantial evidence exists when a "reasoning mind reasonably could have reached the factual conclusion the agency reached." *Bd. of Physician Quality Assur. v. Banks,* 354 Md. 59, 68 (1999) (quoting *Bulluck v. Pelham Woods Apts.,* 238 Md. 505, 512 (1978)).

An agency's interpretation of law is afforded less deference upon review. "More weight is appropriate when the interpretation resulted from a process of 'reasoned elaboration' by the agency, when the agency has applied that interpretation consistently over time, or when the interpretation is the product of contested adversarial proceedings or formal rule making." *Cty. Commissioners of Carroll Cty.*, 465 Md. at 204. However, courts are "under no constraints in reversing an administrative decision which is premised solely on an erroneous conclusion of law." *Md. Bd. of Physicians. v. Elliot*, 170 Md. App. 369, 406 (2006).

IV. DISCUSSION

Petitioner argues that the Permit is deficient under both federal and state law due to the lack of effluent limitations restricting the ability of CAFOs and MAFOs to discharge ammonia in the Bay. First, Petitioner alleges that the MDE's finding that gaseous ammonia is not within the purview of the CWA is an erroneous conclusion of law based on several statutory definitions contained within the CWA and the Environment Article of the Annotated Code of Maryland. According to Petitioner, these definitions greatly expand the MDE's reach and demand the regulation of gaseous ammonia discharged by CAFOs and MAFOs. Alternatively, Petitioner argues that the factual conclusions relied on by the MDE in their decision making process are not supported by the administrative record. Current limitations, both technology based, and water quality based, disregard ammonia emissions entirely and, according to Petitioner, any finding that such limitations are sufficient is arbitrary. The Court will address Petitioner's first argument below.

Whether the MDE erroneously concluded that gaseous ammonia emissions are not governed by the CWA and the Environment Article

As stated above, deference is owed to an agency's interpretation of law. The Court, however, may substitute its judgment if there are erroneous conclusions of law. *See Md. Dept. of Environment v. Ives*, 136 Md. App. 581, 585 (2001). The amount of deference owed to a legal conclusion varies and "more weight is appropriate when the interpretation resulted from a process of 'reasoned elaboration' by the agency, when the agency has applied that interpretation consistently over time, or when the interpretation is the product of contested adversarial proceedings or formal rule making." *Cty. Commissioner of Carroll Cty*, 465 Md. at 203–04 (quoting *Balt. Gas & Electric Co. v. Pub. Service Comm'n*, 305 Md. 145, 161 (1986)). "Nevertheless, the rule is firmly established that when statutory language is clear and unambiguous, administrative constructions, no matter how well entrenched, are not given weight." *Macke Co. v. Comptroller of the Treasury*, 302 Md. 18, 22–23 (1984).

A court must determine the meaning of a statute based on several relevant factors and must read the "words in the context of the entire legislative scheme and in a way that does not lead to a nonsensical construction." *Employees' Retirement System of City of Baltimore v. Dorsey*, 430 Md. 100, 115 (2013) (analyzing the meaning of "impairment" in Baltimore City Code). In *Cty. Commissioners of Carroll Cty.* the Court explained:

> In construing a statute, a reviewing court applies the oft-stated approach to statutory construction. That is, the court seeks to ascertain legislative intent – whether that of the General Assembly or of Congress. That endeavor begins with the plain meaning of the text, keeping in mind that the plainest language is controlled by the context in which it appears. The legislative history of the statute may then be reviewed to understand the purpose of the legislation, resolve ambiguities, and confirm the apparent meaning of the text. Past case law construing a provision is, of course, also helpful.

465 Md. at 203.

This Court has applied the foregoing principles in its analysis of the legal conclusion reached by the MDE that gaseous ammonia is outside the purview of the CWA. This Court finds that the MDE's legal conclusion is erroneous based on both the language and legislative intent of the Environment Article. The Court bases this finding on the statutory definition of "emitting" and "pollutant."

Maryland's expansion of the CWA unambiguously includes gaseous ammonia.

Maryland's legislators made their intent to expand the CWA clear through the codification of their legislative policy in the Environment Article. *See* § 9-302 (stating: "The purpose of th[e] subtitle is to establish effective programs and to provide *additional and cumulative* remedies to prevent, abate, and control pollution of the waters of this State") (emphasis added).

This intent is exemplified by the adoption of broad key terms throughout Maryland's water pollution control laws. Of particular relevance is the term "pollutant," defined as "any liquid, *gaseous*, solid, or other substance that will pollute any waters of this State." § 9-101(g)(2) (emphasis added). Of further importance is the term "discharge," which is defined as "the addition, introduction, leaking, spilling, or *emitting* of a pollutant into the waters of this State." § 9-101(b)(1) (emphasis added). Notably "pollutant" is not only limited to wastewater. *See* § 9-101 (g)(1) (defining pollutant as "any *waste* or wastewater that is discharged from" either a water treatment work or industrial source").

The clear intent to expand the CWA's reach, and the broadened definitions contained in the Environment Article, require the MDE to regulate ammonia as a water pollutant. In coming to this conclusion, the Court examines first the definition of several words contained in § 9-101, specifically the words "gaseous" and "emitting."

Ammonia is a gaseous pollutant under § 9-101.

Merriam-Webster defines "gaseous" as something "having the form of or being gas" or "lacking substance or solidity." MERRIAM-WEBSTER.COM, https://www.merriam-webster.com/dictionary/gaseous. Ammonia is a form of nitrogen and is emitted from poultry waste through a process called volatilization. Through this process ammonia changes composition and converts to a gas emitted by manure inside poultry houses and manure storage sheds. Admin. R. at 000290-91; 000484-86. Accordingly, ammonia is a gaseous pollutant in accordance with § 9-101 and is subject to regulation by the MDE under the Environment Article. § 9-323(a)(1). Any other interpretation of ammonia would "lead to a nonsensical construction" that greatly inhibits the MDE's ability to protect the Bay. *Dorsey*, 430 Md. at 115.

CAFOs emit gaseous ammonia into the bay through the use of industrial fans.

CAFOs and MAFOs in Maryland actively emit gaseous ammonia into the Bay designating them as dischargers of pollutants in accordance with § 9-101 of the Environment Code. *See* Admin. R. at 000484-85, Wheeler, Eileen F., et al, "Ammonia emissions from twelve

US broiler chicken houses." Transactions of the ASABE 49.5 (2006) 1495-1512. Merriam-Webster defines "emit" as "to throw or give off or out." MERRIAM-WEBSTER.COM, https://www.merriam-webster.com/dictionary. In applying this definition to the case at hand, it is clear that CAFOs in Maryland, particularly CAFOs operating as poultry farms, emit gaseous ammonia by discharging noxious fumes onto the waters of the State via industrial fans.

Regulating gaseous ammonia does not expand the CWA.

MDE argues that the interpretation discussed above, propounded by Petitioner, and supported by the applicable law, is too broad and would necessitate water discharge "permits for things as varied as 'cars and chimneys.'" MDE Memorandum at 17 (citing *Chemical Weapons Working Group, Inc. v. U.S. Dep't of the Army*, 111 F.3d 1485, 1490 (10th Cir. 1997)). MDE relies on *Chemical Weapons Working Group, Inc. v. U.S. Dept. of the Army* [hereinafter referred to as "*Chemical Working Group*"] to support its argument. The facts in that case, however, are distinguishable from the facts at hand.

In *Chemical Working Group*, the Tenth Circuit was tasked with determining whether the government's one-time destruction of chemical weapons, pursuant to Congressional authorization, violated § 301(f) of the CWA, which proscribed the introduction of chemical weapons to waterways. The Court rejected the Army's argument, holding that its interpretation of the CWA "is completely at odds with Congressional knowledge, approval, and funding of [the] incineration" of chemical weapons. *Id.* at 1490.

The petitioner in *Chemical Working Group* then argued that the pollution created from incineration would ultimately fall back to Earth, polluting waterways in violation of the CWA. *Id.* The Court similarly rejected that claim as irrational. *Id.* Under that logic, the Court opined that such a broad interpretation of the CWA would lead to permitting of "sources of water pollution such as cars and chimneys." *Id.* Implicit in the Court's determination was the idea that point sources should not be responsible for the indirect, attenuated introduction of pollutants which may, or may not enter the water at an unknown point in the future. See *id.* (the petitioner's argument "would necessarily result in regulation under § 301(a) of any air emission that might possibly result in atmospheric deposition into navigable waters").

The MDE urges this Court to apply the same logic but the Court declines to do so in light of key factual differences between the matter at hand and in *Chemical Working Group*. The incineration of chemical weapons in violation of the CWA's absolute prohibition against doing so in *Chemical Working Group* was expressly authorized by Congressional statute. Here, no authorization exists from either Congress or the Maryland General Assembly that enables CAFOs and MAFOs to dump ammonia into the Bay. Rather, Maryland has chosen to strengthen the CWA by broadening the key definitions of emit and gaseous as discussed above.

Further, the pollution discussed in *Chemical Working Group* was the result of the onetime incineration of chemical weapons and the connection between the government's actions and violation of the CWA through water pollution was tenuous. 111 F.3d at 1487–89. In contrast, CAFOs continuously and repeatedly emit ammonia directly into the Chesapeake Bay with roughly 40% of emitted ammonia redepositing within 2.5 kilometers, or 1.5 miles, of the source. Admin. R. at 000485. Additionally, 70% of emitted ammonia is redeposited within 50 kilometers, or 31 miles, of the source. *Id.* The introduction of ammonia from CAFOs cannot be compared to the theoretical reintroduction of chemical pollutants discussed in *Chemical Working Group* as the record in this case indicates that there is a definite and real impact on the Bay. *Cf. Chem. Working Group*, 111 F.3d at 1490–91 (questioning the connection between the incineration of chemical weapons and water pollution).

The Court finds no support for MDE's argument that interpreting the Environment Article to include the emission of gaseous ammonia will lead to the regulation of tenuous forms of water pollution originating from the air. The concrete and measurable nature of the pollution in this case does not justify the broad view of the CWA that MDE warns of. Again, the theoretical reintroduction of pollutants that were originally discharged some time and distance away is simply not comparable to the facts at hand. The record reflects that ammonia discharge is a specific, calculable event that the MDE is obligated to regulate in accordance with their responsibility to properly administer the CWA. Admin. R. 000473–76. The Court finds that this conclusion is consistent with both the language and policy of the Environment Article and poses no risk of over expanding the MDE's permitting responsibilities beyond what is already statutorily prescribed.[2] The MDE erred as a matter of law in concluding that gaseous ammonia emissions are not governed by the CWA and the Environment Article.

CONCLUSION

For the reasons set forth above, the Maryland Department of the Environment's final determination is REVERSED. The Permit is remanded to the MDE to mandate effluent limitations for ammonia and other water quality based effluent limitations.

A separate order will be entered.

March 11, 2021

Sharon V. Burrell

SHARON V. BURRELL, Judge
Circuit Court for Montgomery County, Maryland

[2] In light of the Court's ruling that MDE committed an error of law, it will not address Petitioner's argument that MDE's factual conclusions are not supported by the administrative record.

IN THE CIRCUIT COURT FOR MONTGOMERY COUNTY, MARYLAND

IN RE PETITION OF ASSATEAGUE COASTAL TRUST FOR JUDICIAL REVIEW OF THE DECISION OF: THE MARYLAND DEPARTMENT OF THE ENVIRONMENT IN THE MATTER OF: LAND AND MATERIALS ADMINISTRATION DETERMINATION TO RE-ISSUE GENERAL DISCHARGE PERMIT FOR ANIMAL FEEDING OPERATIONS STATE DISCHARGE PERMIT #19AF/ NPDES # MDG01	: : : : : : : : : : : : : : : :	Case No.: 482915-V

ORDER

Upon consideration of Assateague Coastal Trust's Petition for Judicial Review, and for the reasons set forth in the accompanying memorandum opinion, it is this 11th day of March, 2021, by the Circuit Court for Montgomery County, Maryland, hereby

ORDERED, that the Maryland Department of the Environment's final determination is REVERSED; and it is further

ORDERED, that Maryland Permit No. 19AF/National Pollution Discharge Elimination System Permit No. MDG01 is remanded to the Maryland Department of the Environment to mandate effluent limitations for ammonia and other water quality based effluent limitations.

Sharon V. Burrell

SHARON V. BURRELL, Judge
Circuit Court for Montgomery County, Maryland

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APPENDIX 3

Appellant MDE Brief to the Court of Special Appeals

IN THE
COURT OF SPECIAL APPEALS OF MARYLAND

September Term, 2021

No. 209

MARYLAND DEPARTMENT OF THE ENVIRONMENT,

Appellant,

v.

ASSATEAGUE COASTAL TRUST,

Appellee.

On Appeal from the Circuit Court for Montgomery County
(Sharon V. Burrell, Judge)

BRIEF OF APPELLANT

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March 30, 2022

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IN THE
COURT OF SPECIAL APPEALS OF MARYLAND

September Term, 2021

No. 209

MARYLAND DEPARTMENT OF THE ENVIRONMENT,

Appellant,

v.

ASSATEAGUE COASTAL TRUST,

Appellee.

On Appeal from the Circuit Court for Montgomery County
(Sharon V. Burrell, Judge)

BRIEF OF APPELLANT

STATEMENT OF THE CASE

This case involves the extent to which the Maryland Department of the Environment must regulate air emissions through the issuance of a water pollution control general permit covering the operation of poultry houses and other animal feeding operations or "AFOs." The Department crafted the general permit to allow for the limitation of air emissions on a site-specific basis if the circumstances of a particular poultry house indicated that its emissions would be deposited into nearby waters of the State. Appellee, the Assateague

Coastal Trust, challenged the permit, arguing that the Department was required to include within the general permit an across-the-board effluent limitations that would be applicable to the gaseous ammonia emissions from *all* poultry houses regardless of their proximity to receiving streams and other topographical features. (E. 2, 13, 110-12.) The Circuit Court for Montgomery County (Burrell, J.) agreed with the Trust and, in a March 12, 2021 opinion, reversed the Department's decision to issue the permit, and remanded for the Department to impose effluent limitations and other water quality-based effluent limitations for gaseous ammonia. (E. 20-21.) On April 12, 2021, the Department timely appealed that decision to this Court. (E. 6.)

QUESTION PRESENTED

Was the Department's final determination to require individualized assessments of gaseous emissions for poultry houses and other animal feeding operations covered by the general permit supported by substantial evidence in the record and not arbitrary and capricious?

STATEMENT OF FACTS

The Federal Clean Water Act

Congress enacted the Clean Water Act in 1972 among other media-specific environmental laws enacted in the wake of 1960s activism, including the Clean Air Act (1970), the Endangered Species Act (1973), and the Federal Insecticide, Fungicide & Rodenticide Act (1972). *See* Pub. L. 92-500 (codified at 33 U.S.C. § 1251 through 1387). The Clean Water Act seeks to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" largely by prohibiting the discharge of pollutants unless in compliance with a permit issued under the National Pollutant Discharge Elimination System ("NPDES"). *See* 33 U.S.C. §§ 1311(a), 1342. An NPDES permit places limits on the type and quantity of pollutants that can be released into the Nation's waters. *See Maryland Dep't of the Envir. v. Anacostia Riverkeeper*, 447 Md. 88, 96 (2016). These limits are called "effluent limitations." *See* 33 U.S.C. § 1362(11) (defining an effluent limitation as a restriction "on quantities, rates, and concentrations of chemical, physical, biological, and other constituents which are discharged from point sources into navigable waters").

In relevant part, the Clean Water Act directs the U.S. Environmental Protection Agency ("EPA") to issue nationally applicable effluent limitations guidelines for classes or categories of point sources. 33 U.S.C. § 1314(b). The guidelines—often referred to as "ELGs"—consist of industry-specific, technology-based effluent limitations, which require the use of the best practicable control technology currently available that will result in reasonable progress toward the national goal of eliminating the discharge of all pollutants. *See* 33 U.S.C. §§ 1311(b)(1), 1314(b)(1).

EPA has promulgated ELGs for concentrated animal feeding operations or "CAFOs," which are those animal feeding operations that exceed certain size thresholds and discharge pollutants into navigable waters.[1] The guidelines for CAFOs take the form

[1] In contrast to CAFOs, *Maryland* animal feeding operations ("MAFOs") meet the CAFO size criteria but discharge pollutants only into *ground*water, not navigable waters, and thus are regulated by the State only. Operations that do not meet the CAFO size thresholds remain simply "AFOs" and are regulated only by the State. *See generally*

of best management practices ("BMPs"), which are non-numerical effluent limitations, but "are still technology-based because they are based on the technology standards prescribed by the [Clean Water] Act." *Waterkeeper Alliance Inc. v. E.P.A.*, 399 F.3d 486, 496 (2nd Cir. 2005); *see also* 40 C.F.R. § 122.44(k) (describing the circumstances in which EPA may promulgate BMPs in the place of numerical ELGs). When issuing a permit, the Department is directed to use the best practicable control technology currently available—as established by any ELG that is applicable to the facility—to achieve a level of water pollution control that produces the least impact on water quality. *See* 40 C.F.R. § 125.3(a)(2)(i); COMAR 26.08.01.02D. Here, the CAFO guidelines require the implementation of BMPs to address three particular sources of pollution that are commonly generated by CAFOs: manure, litter, and process wastewater. *See, e.g.*, 40 C.F.R. § 412.31.

Delegation of Permit Authority to Maryland

The Clean Water Act allows for EPA to delegate its NPDES permitting authority to a state. *See* 33 U.S.C. § 1342(b)(1). Through a Memorandum of Agreement dated May 18, 1989, EPA has authorized Maryland to issue NPDES permits pursuant to a state permit program. *See Piney Run Pres. Ass'n v. County Comm'rs of Carroll County*, 268 F.3d 255,

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COMAR 26.08.01.01B(13-2); 40 C.F.R. § 122.23(b)(2); 40 C.F.R., Part 412; *see also Assateague Coastkeeper v. Maryland Dep't of Env't*, 200 Md. App. 665, 678-79 (2011) (discussing the different types of AFOs in Maryland).

265 (4th Cir. 2001) (noting that EPA had authorized approximately forty states, including Maryland, to issue NPDES permits).

As part of its delegation, Maryland has adopted a statutory framework that parallels federal law. A person may not discharge any pollutant to waters of the State unless authorized in a permit issued by the Department. Md. Code. Ann., Envir. §§ 9-322, 9-323 (LexisNexis 2014). A person is required to obtain a discharge permit before they may construct, install, modify, extend, alter, or operate (1) an industrial, commercial, or recreational facility or disposal system, (2) a State-owned treatment facility, or (3) any other outlet or establishment, if that operation "could cause or increase the discharge of pollutants into the waters of the State." *Id*. § 9-323(a).

When issuing a discharge permit under these provisions, the Department must ensure that the permitted discharges will meet "[a]ll applicable State and federal water quality standards and effluent limitations." *Id*. § 9-324(a)(1). The Department must use the best available control technology established by any applicable ELG as the minimum level of water pollution control in a permit. *See* 40 C.F.R. § 125.3(a)(2)(i); COMAR 26.08.01.01B(10); COMAR 26.08.03.01C(2)(b). Because MDE issues NPDES permits pursuant to both State and federal authority, EPA retains oversight over MDE's NPDES permit program and the NPDES permits it issues.[2] *See* 33 U.S.C. § 1342(d)(2); 40 C.F.R. § 123.44.

[2] The general permit at issue here is both a State discharge permit and an NPDES permit. *See* COMAR 26.08.04.08; 26.08.04.09N.

Although the Department authorizes some discharges through "individual discharge permits" that set forth requirements specifically tailored to a particular discharger, the Department also issues "general discharge permits" where a particular industry or category of discharges are susceptible to regulation under common terms and conditions. *See* 40 C.F.R. §§ 122.28(a), 123.25; COMAR 26.08.04.08-.09. General discharge permits include conditions and other eligibility requirements that a facility must meet to obtain coverage under the general permit. *See id.* EPA and MDE both have chosen to regulate CAFOs under general permits. *See* COMAR 26.08.04.09N; *see also* 40 C.F.R. § 122.23(h).

The AFO General Discharge Permit

Maryland began regulating CAFOs through regulations and a general permit originally adopted in 1996. At various times since then, Maryland has re-issued the general permit and its governing regulations, strengthening them over time. *See Assateague Coastkeeper*, 200 Md. App. at 678-79 (discussing evolution of CAFO general permits in Maryland). The Department proposed the most recent iteration of the general permit in 2019, and as it did with the prior iterations, submitted its proposal to EPA for its review under 40 C.F.R. § 123.44. That provision gives EPA the opportunity to object to state-issued general permits to "ensure compliance" with the "CWA or any guidelines or regulations" and to ensure that the state-issued permit will "[a]chieve water quality standards." 40 C.F.R. § 123.44(c)(1), (4), (8) (incorporating requirements of 40 C.F.R. § 122.44(d)). The Department and EPA corresponded with one another regarding various provisions and requirements in the draft permit. (E. 213-15.) After including EPA's suggested modifications, the Department published a tentative determination to renew the permit. (E. 161-62 (tentative determination); E. 163-78 (fact sheet); E. 179-212 (draft general permit).) EPA did not exercise its statutory authority to object to that determination.

The proposed permit imposed a "zero discharge" limitation for CAFOs, which prohibits all discharges of pollutants to surface and ground waters from CAFO production areas.[3] *See* 40 C.F.R. § 412.46; *see also* COMAR 26.08.03.09B; (E. 184.) The premise of a "zero-discharge permit" is that the proper design and implementation of onsite BMPs will either prevent nutrient loss or allow for nutrient-uptake by vegetation, thereby eliminating actual discharges to surface and ground waters. *See* 68 Fed. Reg. 7176, 7179 (Feb. 12, 2003). The permit accomplishes this by requiring both CAFOs and MAFOs to develop and implement for their production areas a nutrient management plan—referred to as a "Required Plan"—that meets the requirements of 40 C.F.R. § 122.42(e) and applicable effluent limitations and standards, including the CAFO-specific ELGs set forth in 40 C.F.R. Part 412. (E. 190-91.)

The Required Plan establishes operational and management practices regarding, among other things, waste storage, animal confinement, and land application areas so as to prevent the discharge of pollutants to waters of the State. The Required Plans are site-specific and prepared by nutrient management planners who are licensed and certified by

[3] "Production area" is defined to mean, among other things, the animal confinement area of an AFO, including all housed lots and confinement houses. *See* 40 C.F.R. § 412.2(h); (E. 187).

the Maryland Department of Agriculture. (E. 187; 192.); *see* COMAR 15.20.04 (licensing regulations setting forth educational and examination requirements).

The Required Plans must ensure that appropriate measures are employed to store, stockpile, and manage animal manure and waste nutrients associated with animal production in accordance with state and federal requirements, including certain standards and specifications developed by the U.S. Department of Agriculture's Natural Resources Conservation Service ("NRCS"). *See* 40 C.F.R. § 122.42(e)(1)-(6); COMAR 26.08.01.01B(53-1). The plans must be based upon an assessment of possible "resource concerns" and implement applicable NRCS conservation standards where resource concerns exist. *See* 40 C.F.R. § 122.42(e)(1)-(6); COMAR 26.08.01.01B(53-1). (E. 191.)

A "resource concern" is a term of art, defined in the NRCS National Planning Procedures Handbook, Title 180, § 600.2(120), as "an expected degradation of the soil, water, air, plant, or animal resource base to the extent that the sustainability or intended use of the resource is impaired." (E. 237.) Air quality-based resource concerns include "airborne soil and smoke particulates that can cause safety-related problems, machinery and structure damage, health problems, deposition of airborne sediment in water conveyances, airborne chemical drift, odors, and fungi, molds, and pollen." NRCS National Planning Procedures Handbook, Title 180, § 600.2(3). (E. 227.) Pursuant to Part IV.D of the general permit, and particularly relevant to this appeal, Required Plans must address the following aspects of any "resource concerns" about an AFO's air emissions:

> 1. Odors: The facility shall be operated at all times to minimize nuisance odors associated with process wastewater treatment and storage operations from escaping the facility boundaries.

2. For poultry: If outdoor air quality is determined to be a resource concern, use appropriate NRCS Practice Standards to address the concern.

(E. 200.)

The Department reviews each Required Plan to ensure that its management practices are sufficiently protective given the specific circumstances of the farm, the surrounding topography, and the proximity of any waterways that may be affected by the farm's operations. (E. 190-91.) The Department also retains the authority to require additional BMPs if it determines that they are necessary to implement the provisions of the general permit consistently with maintaining water quality standards. (E. 191.)

After the licensed plan-writer prepares the plan and submits it to MDE, the Required Plan is subject to an opportunity for public review, comment, and public hearing in accordance with COMAR 26.08.04.09N(3). (E. 191-92.) Any person aggrieved by the Department's final approval of a Required Plan may request a contested case hearing. COMAR 26.08.04.09N(3)(l)(ii). The terms of an approved Required Plan are incorporated into the GDP as permit conditions that are enforceable by the Department. (E. 192.)

The Permitting Process and Appeal

During the public comment period on the proposed permit, the Department received numerous comments, including comments from the Assateague Coastal Trust, which maintained that the permit was deficient because it did not include across-the-board limitations on gaseous ammonia emissions from poultry AFOs. (E. 95-130.) In its comments the Trust cited a pre-publication copy of a study indicating that approximately 40% of ammonia emissions from Eastern Shore CAFOs were redeposited within 1.5 miles of the source, and approximately 70% was redeposited within 31 miles. (E. 111.) MDE also received comments from the Delmarva Poultry Industry, Inc., which took the position that the Department had no authority to regulate odors or air quality through the general permit. (A.R. 467.)

After reviewing the testimony and written comments received during the public participation process, the Department prepared a report of its findings that summarized the comments and identified several revisions to the general permit in response to those comments. MDE did not, however, modify the draft permit's approach for addressing air emissions from poultry operations; the Department maintained that the draft permit already required the implementation of site-specific measures to address odors and other air quality resource concerns under NRCS practice standards. (E. 87.) The Department's response further noted that the NRCS practice standards provided many different ways to address the potential for ammonia emissions from poultry houses, including litter amendments, hedgerow plantings, and wind breaks or shelterbelts. *Id*. Accordingly, MDE finalized the general permit and issued it effective July 8, 2020. (E. 57-58 (final determination); E. 59-76 (fact sheet); E. 22-56 (General Discharge Permit for Animal Feeding Operations ("AFOs"), State Discharge Permit No. 19AF/National Pollutant Discharge Elimination System ("NPDES") Permit No. MDG01).)

On July 23, 2020, the Trust timely requested judicial review of the general permit in the Circuit Court for Montgomery County. (E. 2.) In the briefing and hearing that followed, the Trust maintained the position it took in its comments, while the Department argued that air emissions from CAFOs were not appropriately regulated under water pollution control authorities or through across-the-board effluent limitations, and that the general permit provided substantial protection of water quality through the implementation of site-specific BMPs designed to prevent discharges of pollutants into waters of the State. On March 11, 2021, the circuit court issued a decision in which it concluded that the Department had the authority to regulate air emissions through its water pollution control permits and that it was required to exercise that authority through the imposition of across-the-board effluent limitations. (E. 8-21.) The circuit court based its conclusion in large part on the study cited by the Trust, which it read as indicating that CAFOs "emit ammonia directly into the Chesapeake Bay." (E. 18.) Accordingly, the circuit court vacated the general permit and remanded for the Department to "mandate effluent limitations for ammonia and other water quality based effluent limits." (E. 20.) This appeal followed. (E.6.)

ARGUMENT

I. THE DEPARTMENT'S REISSUANCE OF THE GENERAL PERMIT IS SUBJECT TO THE DEFERENTIAL SUBSTANTIAL EVIDENCE AND ARBITRARY AND CAPRICIOUS STANDARD OF REVIEW.

This Court looks through the decision of the circuit court and evaluates an agency's permitting decision directly. *People's Counsel for Baltimore Cty. v. Surina*, 400 Md. 662, 681 (2007). It conducts that review on the administrative record compiled before the Department at the time of its final determination, and it is generally limited to those objections raised during the public comment period. Envir. § 1-601(d)(1).

The Department's decision to issue an NPDES permit is reviewed on the substantial evidence and arbitrary and capricious standards. *Anacostia Riverkeeper*, 447 Md. at 118-22. In applying the substantial evidence test, the court decides "whether a reasoning mind reasonably could have reached the factual conclusion the agency reached." *Id*. at 120; *see also Motor Vehicle Admin. v. Shea*, 415 Md. 1, 18 (2010). The test is one of "reasonableness, not rightness." *Board of Physician Quality Assurance v. Mullan*, 381 Md. 157, 173 (2004). And courts "must accord an agency great deference regarding factual questions involving scientific matters in its area of technical expertise." *Anacostia Riverkeeper*, 447 Md. at 120.

The court must also address whether the administrative decision is premised upon an erroneous conclusion of law. *Id*. at 122. The court reviews an agency's legal conclusions de novo, but it accords "a degree of deference" to "the position of the administrative agency." *Motor Vehicle Admin. v. Sanner*, 434 Md. 20, 31 (2013). "[A]n administrative agency's interpretation and application of the statute which the agency administers should ordinarily be given considerable weight by reviewing courts," *id*., particularly where "the regulation concerns 'a complex and highly technical regulatory program,' in which the identification and classification of relevant 'criteria necessarily require significant expertise and entail the exercise of judgment grounded in policy concerns,"' *Thomas Jefferson Univ. v. Shalala*, 512 U.S. 504, 512 (1994).

Overall, the agency's decision is viewed in the light most favorable to the agency, as its decisions are "prima facie correct" and carry with them "the presumption of validity." *Giant Food, Inc. v. Department of Labor, Licensing and Regulation*, 356 Md. 180, 185

(1999). The arbitrary and capricious standard of review is "extremely deferential." *Anacostia Riverkeeper*, 447 Md. at 120. Under that standard, a court is to consider "whether the agency 'relied on factors which Congress had not intended it to consider, entirely failed to consider an important aspect of the problem, offered an explanation for its decision that runs counter to evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise.'" *Id*. at 120-21 (internal citations omitted). The reviewing court must be satisfied from the record that the agency "'examine[d] the relevant data and articulate[d] a satisfactory explanation for its action.'" *Id*. at 121 (citation omitted).

II. THE GENERAL PERMIT PROPERLY IMPLEMENTS FEDERAL AND STATE EFFLUENT LIMITATIONS FOR GASEOUS EMISSIONS THAT ARE DISCHARGED INTO WATERS OF THE STATE.

The Trust argued below, and the circuit court held, that the Department's final determination to issue the general permit was arbitrary and capricious and not supported by substantial evidence in the record because it does not place mandatory controls on the emission of gaseous ammonia from all poultry CAFOs. (E. 8-19.) As discussed below, that circuit court's holding was erroneous, as MDE reasonably determined that the science does not support an across-the-board limitation but instead requires a site-specific evaluation of each permitted facility's operations and their impact on water quality.

A. The Department Reasonably Determined that the Regulation of Air Emissions From Poultry CAFOs Requires a Site-Specific Analysis.

As the circuit court observed, Maryland law is broader than the federal Clean Water Act in several respects and provides a textual basis for regulating air emissions through the issuance of a water pollution control permit. The term "discharge" is defined under Maryland law as the "addition, introduction, leaking, spilling, or *emitting* of a pollutant into waters of this State," Envir. § 9-101(b) (emphasis added), and the term "pollutant" is defined as "any other liquid, *gaseous*, solid, or other substance that will pollute any waters of this State," *id*. § 9-101(g) (emphasis added). And when MDE issues a joint state and federal discharge permit—such as the general permit at issue here—it must protect against discharges that are subject to federal *and* Maryland law. *See Assateague Coastkeeper*, 200 Md. App. at 677, 723 (noting how, in contrast to the CWA, Maryland law regulates CAFOs that both propose to discharge and discharge into groundwater); *see also* Envir. § 9-101(b)(2), (l).

Despite the breadth of the Department's statutory authority, its powers are not unlimited. To regulate a facility, the Department must make a reasoned decision that "its operation could cause or increase the discharge of pollutants into the waters of this State." Envir. § 9-323. Unlike the management of manure, litter, and process wastewater, which both the EPA and MDE have categorically determined are likely to result in jurisdictional discharges, whether ammonia emissions from a CAFO would result in a discharge into jurisdictional waters requires analysis of the site's specific circumstances—its proximity to waterways, the prevalence of forest or other vegetative cover, and meteorological conditions to name a few.

In MDE's expert view, the science does not yet support the conclusion that ammonia emissions from CAFOs result in discharges to waterways with sufficient frequency to justify an across-the-board effluent limitation applicable to the entire CAFO industry.

MDE and EPA are working to close that knowledge gap; MDE is monitoring the effect of CAFO ammonia emissions on ambient air quality, (E. 87); *see* https://mde.maryland.gov/programs/Air/AirQualityMonitoring/Pages/Lower-Eastern-Shore-Monitoring-Project_Beginings.aspx, and EPA is in the process of finalizing poultry air emission models for AFOs (E. 110). *See also* https://www.epa.gov/system/files/documents/2021-08/development_of_emissions_estimating_methodologies_for_broilers.pdf. But based on current state of the science, MDE reasonably concluded that an across-the-board limitation on ammonia emissions from CAFOs—regardless of their specific circumstances—was not justified by the science.

Before the agency and the circuit court, the Trust relied heavily on one of the few studies in this area. That study—which we refer to as "the Baker Study" after its principal author—modeled ammonia emissions from poultry houses on the Eastern Shore and concluded that approximately 40% of those emissions were redeposited within 1.5 miles of the source, and approximately 70% was redeposited within 31 miles. (E. 448-71 (published as Baker J, et al. "Modeling and measurements of ammonia from poultry operations: Their emissions, transport, and deposition in the Chesapeake Bay," Science of the Total Environment, 706:135290 (March 1, 2020).) The Baker Study is undoubtedly an important contribution to the body of scientific knowledge about air emissions from poultry houses, but its findings are abstract and theoretical, as the study itself rightly acknowledges.

For example, the authors noted that the dispersion model that they used does not allow for land use to be considered as part of their analysis. (E. 468.) This is an important caveat, as dense forests and other vegetation "will likely limit direct deposition to the

[Chesapeake] Bay by taking up ammonia that would otherwise deposit to the water surface." (E. 468.) Without land use data, the study was not able to model the extent to which ammonia emissions actually make it into waterways because, "[u]nfortunately, determining the deposition to rivers, streams, and tributaries would be very difficult without land-use satellite data." (E. 463.) The lack of site-specific data about the proximity of dense forests and other vegetation was also an "important consideration," as those features tend to be "near rivers and water bodies" and thus "will likely limit direct deposition to the Bay by taking up ammonia that would otherwise deposit to the water surface." (E. 468.) And perhaps most relevant here, the study acknowledges that one of its "important assumption[s]" was that "no waste management practices or environmental technologies are used to mitigate ammonia emissions throughout the modeling domain" (E. 455), and that, specifically, the "use of Best Management Practice (BMP) of using aluminum sulfate in the poultry houses for reducing ammonia emissions was not accounted for" (E. 468). The general permit, of course, explicitly provides for the use of BMPs to mitigate air emissions.

In other respects as well, the study does not support the proposition that CAFO ammonia emissions discharge pollutants into waters of the State at each and every CAFO. The conclusion that the circuit court relied on—that approximately 70% of the ammonia emitted from poultry CAFOs on Maryland's eastern shore would ultimately be redeposited (E. 449)—does not necessarily mean that pollutants will be redeposited in waterways in appreciable quantities. The Baker Study clarified that, of that amount, 90-95% would be redeposited on land, where it may or may not be transported into nearby waterways, depending on local land use features and vegetative cover—two factors that the authors acknowledged their model could not consider. (E. 468); *see also* (E. 41- 43)(General Permit, Part. IV.B.6.b.i - Allowing for the temporary field storage of poultry litter; Part IV.B.8 - Authorizing the land application of manure and process wastewater if agronomic absorption rates are not exceeded.)

This is not to say that the Baker Study is not important; it plainly is. But it does not support the conclusion that the site-specific approach that MDE has chosen is arbitrary, capricious, or unsuited to addressing CAFO air emissions. Science and common sense alike suggest that site-specific factors—distance to a particular waterbody, topography, surrounding land use, vegetative cover, flock size, and fan size and direction—will determine whether gaseous emissions from a particular CAFO are likely to result in a discharge to waters of the State. The Department reasonably determined that a site-specific analysis is needed to evaluate any resource concerns from air emissions and identify appropriate BMPs to address those concerns.

This approach finds further support in the Supreme Court's decision in *County of Maui, Hawaii v. Hawaii Wildlife Fund*, 140 S. Ct. 1462 (2020), which evaluated whether wastewater pumped into underground wells could be considered the "functional equivalent" of a direct discharge to navigable waters when the well had a groundwater connection to navigable waters. After acknowledging the "difficulty" in accounting for the "many potentially relevant factors" that could create or impede such a connection, *id.* at 1476, the Court enumerated several factors that it considered relevant to the evaluation, including: (1) transit time; (2) distance traveled; (3) the nature of the material through which the pollutant travels, (4) the extent to which the pollutant is diluted or chemically changed as it travels, (5) the amount of pollutant entering the navigable waters relative to the amount of the pollutant that leaves the point source, (6) the manner by or area in which the pollutant enters the navigable waters, (7) the degree to which the pollution (at that point) has maintained its specific identity, *id.* at 1476-77.

The same logic applies here. The general permit recognizes that not all gaseous air emissions from CAFOs are sufficiently equivalent to a direct discharge into waters of the State to be regulated under an effluent limitation. Rather than implement a one-size-fits-all approach, the general permit implements an approach whereby the licensed nutrient management plan-writer must consider whether outdoor air emissions present a resource concern based on site-specific considerations, and require the implementation of appropriate NRCS standards to address that concern where it exists.

Two bedrock principles of administrative law support the conclusion that the Department's decision to regulate CAFO air emissions through site-specific NMPs instead of through an across-the-board effluent limitation is entitled to deference. First, agencies, like legislatures, are not required to resolve problems categorically but can instead elect to address the problem first where it is most acute. *See National Ass'n of Broadcasters v. FCC*, 740 F.2d 1190, 1207 (D.C. Cir.1984) (explaining that "agencies, while entitled to less deference than Congress, nonetheless need not deal in one fell swoop with the entire breadth of a novel development; instead, 'reform may take place one step at a time, addressing itself to the phase of the problem which seems most acute to the [regulatory] mind'" (quoting *Williamson v. Lee Optical Co*., 348 U.S. 483, 489 (1955)). "When the

State moves to correct an evil, it need not correct all of the evil at once; rather, it may proceed step by step." *Department of Transp., Motor Vehicle Admin. v. Armacost*, 299 Md. 392, 409-10 (1984). Focusing first on those CAFOs that, based on their specific circumstances, could generate emissions that result in discharges to nearby waterways is consistent with that principle.

Second, "the decision whether to proceed by rulemaking or adjudication lies within the broad discretion of the agency." *Wisconsin Gas Co. v. FERC*, 770 F.2d 1144, 1166 (D.C. Cir. 1985) (citing *SEC v. Chenery Corp*., 332 U.S. 194, 202-03 (1947)). General NPDES permits, like the one at issue here, are "issued pursuant to administrative rulemaking procedures," *Alaska Cmty. Action on Toxics v. Aurora Energy Servs., LLC*, 765 F.3d 1169, 1171 (9th Cir. 2014), whereas the site-specific plan approach that MDE has determined is appropriate here, like an individual NPDES permit, is the result of an "informal agency adjudication process," *id.*, with a right for challengers to request a contested case hearing on the Required Plan for a particular farm. That distinction is important here, as courts "normally defer to an agency's decision to proceed on a case-by-case basis" through site-specific determinations as opposed to an across-the-board rulemaking. *Southern Bell Tel. & Tel. Co. v. F.C.C.*, 781 F.2d 209, 216 n.8 (D.C. Cir. 1986).

Neither principle is a precise fit here, but in the absence of a more comprehensive scientific basis for regulating the atmospheric deposition of CAFO ammonia emissions through across-the-board effluent limitations, they support the Department's decision to assess each poultry CAFO individually to evaluate its ammonia emissions and to require appropriately-tailored BMPs to control those emissions that present a real risk of discharge.

B. *Assateague Coastkeeper* Upheld the Site-Specific Plan Provisions of a Previous Iteration of this Same General Permit.

This Court already held in *Assateague Coastkeeper* that the Department may rely on the development of nutrient management plans to ensure that a CAFO covered by the general permit will not affect water quality. Plaintiff environmental groups had challenged an earlier iteration of this very permit, in part on the grounds that requiring CAFOs to obtain site-specific nutrient management plans did not ensure that "the broad authorization to discharge" reflected in the general permit would comply with water quality standards. 200 Md. App. at 719. This Court rejected that challenge, citing considerations that apply with equal force here.

As in *Assateague Coastkeeper*, the site-specific Required Plans provided for under this iteration of the general permit must be drafted by licensed and certified nutrient management planners and reviewed by MDE to ensure that the specific practices they require are sufficiently protective given the circumstances of the specific farm at issue. *Cf. id*. at 720-21. That review gives MDE the opportunity to impose additional restrictions, identify specific load allocations, and even require that a CAFO owner or operator obtain an individual NPDES permit, if necessary. Each Required Plan then is subject to an opportunity for public review, comment, and public hearing in accordance with COMAR 26.08.04.09N(3), and no CAFO will be issued permit coverage prior to completion of that public review. (E. 35); *cf. Assateague Coastkeeper*, 200 Md. App. at 721 (noting that each nutrient management plan "is subject to public review and comment"). And any person who is aggrieved by the Department's final approval of a Required Plan may request a contested case hearing under Title 10, Subtitle 2, of the State Government Article. *See* COMAR 26.08.04.09N(3)(l).

As in *Assateague Coastkeeper*, the Department has determined that the nutrient management planning process provides the most efficient means to assess whether the operation of a specific CAFO presents a risk to water quality and impose limitations to address that risk. And as in that earlier case, "[i]t was within the province of MDE to determine that this [NMP] process is sufficient to ensure that the issuance of new permits will not cause or contribute to the violation of water quality standards. We will not substitute our judgment for that of the agency on this issue." 200 Md. App. at 721.

C. The Circuit Court's Mandate to Implement Across-the-Board Effluent Limitations Usurps the Agency's Role and Could Lead to Absurd Results.

The circuit court's remand for the Department to include within the general permit mandatory "effluent limits for ammonia and other water quality based effluent limitations" usurps the Department's role under federal and State pollution control statutes. Under the Clean Water Act, the primary benchmarks for achieving clean water are "water quality standards." *See Maryland Dep't of the Env't v. County Comm'rs of Carroll Cnty.*, 465 Md. 169, 185 (2019). These standards are to be based on each specific waterbody's "designated use" (i.e., fishing, recreation, public water supply) and include criteria necessary to support that use. *See* U.S.C. § 1313(c)(2)(A); 40 C.F.R. § 130.3; COMAR 26.08.02.01-.03. To achieve water quality standards, the Act directs EPA to issue nationally applicable effluent limitation guidelines and requires State permitting authorities to implement those guidelines. 33 U.S.C. § 1314(b).

The Department has incorporated EPA's guidelines into the general permit. *See* 40 C.F.R. Part 412; (E. 22, 27). Those guidelines include best management practices, like those that may be required through the development of nutrient management plans, which qualify as non-numeric effluent limitations. *See Waterkeeper*, 399 F.3d at 496; *see also* 40 C.F.R. § 412.4(c); *see also Anacostia Riverkeeper*, 447 Md. at 135 ("We understand effluent limitations to be best management practices."). The general permit includes within it effluent limitations with respect to ammonia, though they are applied on a site-by-site basis through the Required Plan, depending on whether the facility's operations and situation within the landscape require it.

Under federal law, an NPDES permit must include requirements more stringent than technology-based effluent limitation guidelines if necessary to prevent the emission of pollutants that "will cause, have the reasonable potential to cause, or contribute to an excursion above any State water quality standard." *See* 40 C.F.R. § 122.44(d)(1). These more stringent limitations typically take the form of "water quality-based effluent limitations" or "WQBELs." *See, e.g.*, *Carroll Cnty.*, 465 Md. at 187-88. It is this more stringent level of pollution control that the circuit court required MDE to impose on all CAFOs.

But most CAFOs are not subject to WQBELs under federal law. *See* 40 C.F.R., Part 412 (setting only technology-based effluent limitations for CAFOs). EPA prohibits the discharge of pollutants from most CAFOs, *see, e.g.*, 40 C.F.R. § 412.46(a), and it determined that best management practices are sufficient to ensure compliance with this technology-based effluent limitation. *See* 40 C.F.R. § 412.4(c) (requiring the implementation of BMPs for any CAFO that land-applies pollutants); *see also* 40 C.F.R. § 412.46(a)(1). And while EPA empowers state permitting authorities to make the determination whether a discharge in compliance with technology-based effluent limitations nevertheless would cause or contribute to a violation of water quality standards and thus require a WQBEL—40 C.F.R. § 122.44(d)(1); 40 C.F.R. § 122.4(i)—such a determination necessarily relies on site-specific criteria and is, therefore, more appropriately left to a case-by-case evaluation, rather than applied uniformly across an entire industry in the general permit.

As discussed above, the Department has determined that CAFOs operating in compliance with the general permit are not expected to cause or contribute to a violation of water quality standards. WQBELs thus are not necessary as an across-the-board measure, but are instead imposed on a site-specific basis where necessary to protect water quality. That decision is for the Department to make, as the statute provides that "[t]he Department may make the issuance of a discharge permit contingent on any conditions the Department considers necessary to prevent violation of this subtitle." Envir. § 9-326(a)(1). The circuit court's order vacating the requirement for a case-by-case evaluation and requiring mandatory implementation of "effluent limits for ammonia and other water quality based effluent limits" supplants the Department's statutorily delegated role and its expert conclusion that determining whether a CAFO risks a violation of water quality standards requires site-specific review.

And it does so without any hard evidence that deposition from gaseous ammonia emissions causes or contributes to a violation of water quality standards. As discussed above, the study upon which the Trust based its arguments below, while important, does not establish that any particular CAFO will discharge ammonia into waterways or do so in sufficient amounts to present a risk to water quality. Instead, it provides a scientific basis for concluding that ammonia emissions from CAFOs, under certain topographic, vegetative, and meteorological conditions, *could* make it into nearby waterways. The determination of how best to account for that possibility—through across-the-board limitations on the entire industry or on a site-specific basis—is a scientific and factual determination that is entitled to deference. *See Anacostia Riverkeeper*, 447 Md. at 120 (finding the courts are to accord an agency "great deference regarding factual questions involving scientific matters in its area of technical expertise").

In addition to usurping the Department's role, the circuit court's requirement that the Department regulate ammonia emissions in the absence of a site-specific impact on water quality could apply with equal force to other pollutants that are emitted from a wide variety of operations that hold water pollution discharge permits. For example, it is well documented that nitrogen oxides—which present the same potential nitrogen impacts to waters as ammonia—can travel hundreds or thousands of miles through the air before being deposited onto waters or adjacent lands. *See, e.g.*, Cross-State Air Pollution Rule Update for the 2008 Ozone NAAQS, 81 Fed. Reg. 74504, 74514 (Oct. 26, 2016) (discussing inter-state transport of nitrogen oxides from power plants); *see also* https://www.epa.gov/cmaq/estimating-atmospheric-deposition-cmaq (last accessed March 6, 2022). Although ammonia emissions might be redeposited more quickly than nitrogen oxide emissions, that does not provide clear legal grounds for distinguishing between the two, at least without consideration of the conditions of a specific facility.

The logic of the circuit court's ruling could similarly necessitate water discharge permits for things as varied as power plants and automobiles, which emit nitrogen oxides and other pollutants to the atmosphere across the State. These emissions are regulated through permitting authorities implemented under the federal Clean Air Act and its Maryland analog, but it is not clear how they would not also require water-quality based effluent limitations if, as circuit court ruled, MDE has a mandatory duty to regulate those emissions under its water pollution control authorities. That outcome further undermines the legal basis of the circuit court ruling. *See Chemical Weapons Working Grp., Inc., v. U.S. Dep't of the Army,* 111 F.3d 1485, 1490-91 (10th Cir. 1997) (finding that the Clean Water Act did not apply to stack emissions from a government incineration facility because interpreting the statute to include atmospheric deposition from air emissions would be inconsistent with congressional intent, would lead to irrational result, and would create conflict between the Clean Water Act and the Clean Air Act); *see also Yim, LLC v. Tuzeer*, 211 Md. App. 1, 28-29 (2011) (stating that a goal of statutory interpretation is to avoid interpretations that are "absurd, illogical, or incompatible with common sense").

These decisions—whether to regulate a pollutant and, if so, how to regulate it—are for the agency to make based on its expert evaluation of the type of pollution involved, the facilities that emit it, and the science addressing their effect on water quality. That a facility is strictly liable for the discharge of *any* pollutant, regardless of volume, unless authorized by a discharge permit, *see* Envir. § 9-323, COMAR 26.08.03.01A(1), does not itself establish a non-discretionary duty to regulate a discharge, as the Trust argued below. The Department, when issuing a permit, is not required to establish effluent limits for every pollutant known to be discharged from a source. *See Piney Run*, 268 F.3d at 267-68 (NPDES permit shields permittee from liability for pollutant-discharges not expressly mentioned in a permit so long as the permittee made adequate disclosures during the application process regarding the nature of its discharges). Instead, MDE may regulate a facility if it determines that "its operation could cause or increase the discharge of pollutants into the waters of this State," Envir. § 9-323—a determination that MDE reasonably concluded is best made after considering the potential impact that a particular operation has on receiving waters.

CONCLUSION

The judgment of the Circuit Court for Montgomery County should be reversed.

REQUEST FOR ORAL ARGUMENT

Appellant requests oral argument.

Respectfully submitted,

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CERTIFICATION OF WORD COUNT AND COMPLIANCE WITH RULE 8-112

1. This brief contains 6,641 words, excluding the parts of the brief exempted from the word count by Rule 8-503.

2. This brief complies with the font, spacing, and type size requirements stated in Rule 8-112.

/s/ Matthew Standeven
____
Matthew Standeven

MARYLAND DEPARTMENT OF THE ENVIRONMENT, *Appellant*,	*	IN THE
	*	COURT OF SPECIAL APPEALS
v.	*	OF MARYLAND
ASSATEAGUE COASTAL TRUST,	*	September Term, 2021
Appellee.	*	No. 209

* * * * * * * * * * * * * * * *

CERTIFICATE OF SERVICE

I certify that, on this 30th day of March, 2022, the Brief of Appellant in the captioned case was filed electronically and served electronically by the MDEC system on all persons entitled to service, and that on the next business day two copies will be served by first class mail on all parties entitled to service:

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APPENDIX 4

Excerpts from Record Extract

APPENDIX 4, EXHIBIT A

<u>Public Comment Letter to MDE on MDG01; 19AF from Environmental Action Center</u>

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December 26, 2019
Via Electronic Mail

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Land Management Administration
Maryland Department of the Environment
1800 Washington Boulevard
Baltimore, Maryland 21230
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RE: Comments on Draft General Discharge Permit for Animal Feeding Operations

Dear Maryland Department of the Environment (MDE):

Thank you for the opportunity to comment on MDE's Draft General Discharge Permit for Animal Feeding Operations ("draft permit"). These comments are submitted on behalf of Assateague Coastal Trust, Center for Progressive Reform, Chesapeake Legal Alliance, Concerned Citizens Against Industrial CAFOs, Environmental Action Center, Environmental Integrity Project, Maryland League of Conservation Voters, National Association for the Advancement of Colored People - Wicomico County Chapter, Protectors of the St. Martin River, and Waterkeepers Chesapeake.

As stated in the regulatory preamble announcing the availability of the draft permit for public comment, the purpose of the draft permit is to "protect water quality and to comply with federal requirements under Code of Federal Regulations 40 CFR Parts 122, 123, 124, 125, and 412, as well as State requirements under Code of Maryland Regulations (COMAR) 26.08.04.09N." Additional authority cited in the draft permit includes the Clean Water Act, which is designed to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" and Title 9 of the Environment Article of the Annotated Code of Maryland, which charges the Maryland Department of the Environment ("MDE") with an even broader and bolder mission "to improve, conserve, and manage the quality of the waters of this State," "provide that no waste is discharged into any waters of this State without first receiving necessary treatment or other corrective action," and "develop an alternative to discharging wastewater effluent to surface waters, thus pursuing the goal of the Clean Water Act to end the discharge of pollutants and meet the nutrient reduction goals of the Chesapeake Bay Agreement." For the reasons discussed in these comments, we urge MDE to revise the draft permit in order to be consistent with these state and federal directives and to meet these crucial environmental and public health goals.

Please note that all comments in this letter and the references cited herein are submitted for the administrative record and that all references are immediately available upon request.

Summary of Requested Permit Improvements

Below we have summarized some of the specific requests regarding improvements we urge MDE to adopt within the draft permit. This summary of the full comments is provided for convenience but should not be interpreted as an exhaustive list of suggested permit improvements, which are described below in full.

The Draft Permit Is Not Consistent with the Bay TMDL or the Level of Effort Needed to Ensure the State Meets WIP Commitments (Section II)

We urge MDE to include:

- A requirement for identifying nearest waters of the State, their use classes, and identification of impairments
- Removal of discretionary language that merely authorizes, but does not require, additional BMPs or controls consistent with TMDL wasteload allocations
- A requirement that ensures any previously identified resource concerns have been adequately addressed and that any practices associated with an implementation schedule have been fulfilled before the permit issues
- An amendment to the reference in IV.A.1.(b) to include the full checklist of resource concerns identified by the NRCS
- A requirement that the operator fills out a checklist of NRCS conservation practices
- An amendment to require MDE to provide public notice of a 60-day comment period within 30 days of receipt of either a request for permit coverage, request for renewal, or proposed substantial change to a nutrient management plan
- Public access to information regarding whether conservation practices are being installed consistent with implementation schedules
- References in the draft permit to the availability of funds available to assist AFO operators in constructing and installing necessary conservation practices

***Maintaining Existing Permit Conditions is Not Sufficient to Protect Water Quality in the Face of a Changing Climate* (Section III)**

We urge MDE to include:

- A reference to considerations of climatic and precipitation conditions in designing technology-based effluent limitations
- A requirement that all permit applicants and permittees document and report all flood events
- A statement that MDE will reject applications for new AFO facilities at risk from inundation
- A reopener clause for future modifications to the reissued permit to account for forthcoming climate studies and planning processes
- A requirement for on-site manure management practices that mitigate growing greenhouse gas emissions from the industrial agriculture sector

New Language in the Draft Permit Regarding Air Pollution is Inadequate in Light of the Magnitude of Nutrient Pollution Emitted by AFOs (**Section IV**)

- We urge MDE to ensure that the draft permit accounts for and mitigates the enormous amounts of ammonia produced from each poultry house and manure storage shed.

The Draft Permit's Use of the Term "Discharge" is Inconsistent and Problematic (**Section V)**

We urge MDE to remove references to "no discharge" due to:

- Conflicting state and federal definitions of discharge
- The inevitability of discharges resulting from the increasing volume, frequency, and intensity of precipitation in Maryland resulting from climate change
- New scientific certainty regarding the water quality impacts from ammonia emitted from AFOs
- Studies and data showing the increase in pollution concentrations downstream of AFOs relative to upstream baseline conditions

The Vast Majority of Nutrient Pollution Attributable to AFOs Are Land Applied in Adjacent Fields or Exported (**Section VI)**

We urge MDE to:

- Ensure that manure is not land applied as fertilizer in any field under the control of the AFO operator that is within a floodplain or subject to recurring nuisance flooding
- Prohibit land application within at least 100 feet of a tile drain or well used for drinking water due to unacceptable risks of releasing pollution directly to waterways or of contamination of water supplies with nitrates
- Include additional regulatory protections that ensure the manure taken off-site from no-land AFOs is properly accounted for
- Facilitate the implementation of Chapter 760 of 2019 by amending V.B.1.d of the draft permit to specifically include a reference to the end user or final recipient of any manure exported by an AFO
- Include a reference in the permit or in the materials distributed to AFOs during the permit registration process to the resources that are available to AFO operators under the Manure Transport Program
- Modernize the draft permit in line with regulatory efforts in other leading states by utilizing technology to provide real-time decision support tools to operators that minimize the risk of pollution

Siting and Other Criteria for New or Expanded Operations (**Section VII)**

We urge MDE to include:

- A determination of whether the Draft Permit's nine minimum standards to protect water quality, the CNMP requirements, and other BMPs required by the permit satisfy these federal requirements
- A date on any reference to another MDE document or any standards incorporated by reference under the control of MDE or another state agency in the draft permit

- A requirement that any permit for the construction and establishment of a new AFO must be sufficiently tailored to any recognized designations assigned to receiving water bodies
- An amendment to VII.M.2 of the draft permit to remove "at its sole discretion" and add language allowing the public to request permit coverage under an individual permit based on the location of the facility
- Standards regarding where MDE will not accept any applications to operate a new AFO that considers all relevant geospatial data
- A policy in the draft permit to not allow any new or expanded AFOs where any part of the production area or any building footprint will be constructed on an existing wetland or stream of any kind
- A requirement that any new AFO facility offset the total estimated pollution load of the operation from on-site performance standards or potential additional off-site offset options
- A *newly developed* load growth demonstration for the agriculture sector

***Other Needed Permit Improvements (*Section VIII)**

We urge MDE to:

- Amend V.B. of the draft permit to include within the list of items that are required to be in the "Annual Report" the implementation schedule, list of resource concerns identified, and any conservation practices added during the previous year and the full five-year permit term
- Expand Tables 3 and 4 in IV.A to include implementation of conservation practices as described within the broad scope of records to be kept pursuant to IV.B.9.
- Require that all records required to be maintained on site instead be submitted electronically to MDE unless the submission would otherwise be considered infeasible, overly burdensome, or inconsistent with another law; any records kept electronically should be required to be submitted to MDE
- Revise III.A.2, which grants MDE discretion to waive the electronic submission of the notice of intent, to be consistent with federal law and the state's commitments
- Remedy inconsistency with state law by either reinstating the annual fee language from III.F. of the current permit or devising new language that fully complies with the law
- Include more detail in the upset provision, including some examples of what may or may not be considered the cause of an upset
- Include a section consistent with COMAR 26.08.02.04-1F(1) to require applicants for a new or modified AFO to consult the list of Tier II waters and determine if they are located in a catchment or watershed associated with a Tier II water
- Establish that any existing AFOs in a Tier II water should designate "maintenance of healthy waters" as a particular resource concern
- Describe what actions MDE took in response to any engagement with the Commission on Environmental Justice and Sustainable Communities and, if MDE did not engage with the Commission, conduct meaningful outreach with the Commission and concerned residents within disproportionately impacted communities
- Require permittees to submit a sampling plan within a certain period of time
- All results taken according to a sampling plan should be submitted to MDE within a certain period
- Reference the possibility that MDE may require additional on-site monitoring in the future consistent with Chapter 760 of 2019

I. Background

About 95 percent of animal feeding operations ("AFOs") in Maryland are located in the Chesapeake Bay watershed.[1] The Chesapeake Bay is the largest estuary in the United States and the effort to restore the Chesapeake is equally unique, having been recognized as one of the largest ecosystem restoration projects in the world. The Chesapeake Bay Total Maximum Daily Load ("Bay TMDL") has been widely recognized as the single most comprehensive and rigorous of the more than 70,000 TMDLs in the United States, an approach to Bay restoration necessitated by decades of missed deadlines and failed promises by state and local governments.[2]

The Chesapeake Bay model shows that agriculture is the largest source of nutrient pollution to the Chesapeake from Maryland and from the watershed as a whole.[3] The Eastern Shore is home to the vast majority of AFOs in the state and is also where the least progress in reducing phosphorus pollution has been made since 2009 (the TMDL baseline year) compared to any other large basin, including Pennsylvania's Susquehanna basin.[4]

The cause of this lagging progress is not necessarily a lack of effort by farmers. According to data reported by the state, since 2009 Maryland farmers have implemented important pasture management practices on thousands of additional acres, begun implementing conservation tillage practices on tens of thousands of new acres of crop land, and increased the use of pollution reducing cover crops by hundreds of thousands of acres.[5] Instead, the problem is insufficient regulation of AFOs and the construction of hundreds of new poultry houses. More than 12% of nitrogen reaching Eastern Shore streams comes from poultry litter alone, a percentage more than three times greater than the average for streams outside of Maryland's Eastern Shore.[6]

According to the Delmarva Land and Litter Collaborative, poultry AFOs on the Delmarva generated over 550,000 tons of poultry litter in 2018, an amount that has increased each year since 2012 and surged almost

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[1] U.S. Environmental Protection Agency (EPA), Region III, Maryland Animal Agriculture Program Assessment. August 2015. Available at: https://www.epa.gov/sites/production/files/2015-09/documents/marylandanimalagricultureprogramassessment.pdf.
[2] For more information, see the Chesapeake Bay Program's Bay History Timeline. Available at: https://www.chesapeakebay.net/discover/history.
[3] Chesapeake Bay Program, Chesapeake Progress: Modeled Nitrogen Loads to the Chesapeake Bay (2009-2017). Available at: https://www.chesapeakeprogress.com/clean-water/2017-watershed-implementation-plans.
[4] Chesapeake Bay Program, 2017. Chesapeake Assessment and Scenario Tool (CAST) Version 2017d. Chesapeake Bay Program Office, Last accessed October 2019 showing "Edge of Tide" Nitrogen loading to the Chesapeake Bay from each of the 19 State-Basins. Note that this statement applies only to large State-Basins and excludes several small State-Basins responsible for less than 2 percent of total phosphorus pollution delivered to the Chesapeake Bay. The Chesapeake Bay Assessment Scenario Tool is available at: https://cast.chesapeakebay.net/.
[5] Chesapeake Bay Program. Chesapeake Assessment and Scenario Tool (CAST) Version 2017d. Chesapeake Bay Program Office, last accessed April 2019 showing BMPs submitted by each state and for each sector and which BMPs EPA credited for use in the Chesapeake Bay model. The Chesapeake Bay Assessment Scenario Tool is available at: https://cast.chesapeakebay.net/.
[6] Chesapeake Bay Program. Chesapeake Assessment and Scenario Tool (CAST) Version 2017d. Chesapeake Bay Program Office, last accessed December 2019, showing phosphorus load input sources at the edge of stream. The Chesapeake Bay Assessment Scenario Tool is available at: https://cast.chesapeakebay.net/.

18% in only six years.[7] Between 2009 and 2018, nitrogen pollution from broilers increased by 29% in Maryland.[8] According to data from the Delmarva Poultry Industry, the number of poultry houses on the Delmarva increased by 10% and the amount of meat produced increased by 26% since 2010.[9]

This enormous and fast growing source of pollution is having a significant impact on local water quality. According to water quality monitoring data from the United States Geological Survey (USGS), the Choptank River is the only one of the nine major Bay tributaries where both nitrogen and phosphorus pollution levels are continuing to increase over both the short term and long term.[10] Similarly, USGS monitoring shows that nitrogen in the Choptank, Marshyhope, and Nanticoke rivers have continued to increase during the course of the Bay TMDL.[11]

AFOs are also a major source of air pollution on the Eastern Shore, contributing *millions of tons of ammonia* to the air, annually. Ammonia is not only a toxic air pollutant that is an occupational and human health hazard at certain concentrations, but much of the ammonia emitted from poultry houses is deposited nearby as an uncontrolled - and growing - source of nutrient pollution to the Bay and its tributaries and the Atlantic Coastal Bays.

Nitrogen pollution is also a threat to public health in Maryland, as excessive nitrate levels in drinking water can cause "Blue Baby Syndrome" and is increasingly being linked to certain cancers.[12] According to EPA data, only Delaware has a greater percentage of state land with elevated levels of nitrate pollution in groundwater than Maryland.[13] The vast majority of residents of the Eastern Shore are reliant on groundwater for their drinking water supplies.[14] Several public water systems on the Eastern Shore have registered excessive levels of nitrates in their water supplies, and many families rely on residential wells that are not subject to mandatory testing for nitrates and other hazardous pollutants.[15]

Few regions of the watershed are as important to the success of the Chesapeake Bay restoration as the Eastern Shore of Maryland. Due to the area's geology and topography, as well as the increasingly intensive

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[7] Delmarva Land and Litter Collaborative, Exploring Chicken Farming on Delmarva. Available at: https://www.arcgis.com/apps/MapSeries/index.html?appid=ea25550135f04151bd8bee3c247188b2. The DLLC is composed of representatives from the farming community, environmental groups, poultry companies, agricultural businesses, academic institutions, and government agencies, including the Maryland Department of Agriculture and EPA.
[8] Chesapeake Bay Program. Chesapeake Assessment and Scenario Tool (CAST) Version 2017d. Chesapeake Bay Program Office, last accessed November 2019, showing nutrients available to be applied to the land and associated pollution loads. The Chesapeake Bay Assessment Scenario Tool is available at: https://cast.chesapeakebay.net/.
[9] Delmarva Poultry Industry. Delmarva Chicken Production Facts, 1957-2018. Last accessed December 2019. Available at: https://www.dpichicken.org/facts/docs/Delmarva%20Chicken%20Production%20Facts%201957-2018.pdf.
[10] USGS, Chesapeake Bay River Input Monitoring Network 1985-2018: Short- and long-term trends. Last accessed December 2019. Available at: https://www.sciencebase.gov/catalog/item/5cc1c97de4b09b8c0b746e70.
[11] USGS, Short-Term Trends in Loads Between 2007 and 2016. Last accessed December 2019. Available at: https://cbrim.er.usgs.gov/pdf_maps/ST_Trend/ST-NTN2016_TN_Bars.pdf.
[12] International Journal of Environmental Research and Public Health. Drinking Water Nitrate and Human Health: An Updated Review. Last accessed December 2019. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6068531/#.
[13] EPA. Estimated Nitrate Concentrations in Groundwater Used for Drinking. Last accessed December 2019. Available at: https://www.epa.gov/nutrient-policy-data/estimated-nitrate-concentrations-groundwater-used-drinking.
[14] MDE. Maryland's Source Water Assessment Program. Last accessed December 2019. Available at: https://mde.maryland.gov/programs/Water/water_supply/Source_Water_Assessment_Program/Pages/factsheet.aspx.
[15] Environmental Working Group. Fertilizer Runoff Contaminates Drinking Water with Nitrate. Last accessed December 2019. Available at: https://www.ewg.org/interactive-maps/troubleinfarmcountryrevisited/map/.

agricultural practices in this area, what happens on the Eastern Shore will have an outsized impact on the success of this restoration effort. In recent years, the Bay's dead zone has reached historic levels.[16] This may be partly attributed to a stagnation in state efforts to implement their Watershed Implementation Plans (WIPs), but it is also related to impacts of climate change in this region.

Scientists with the Chesapeake Bay Program have developed downscaled climate projections for this region that forecast a greater frequency of unusually intense precipitation events.[17] That forecast has come true, with record rainfalls in both 2018 and 2019.[18] Put simply, the "100-year" storm of centuries past are rendered meaningless today. And as sea levels rise in the Chesapeake and Coastal Bays at a much faster rate than the global average, thanks to additional factors like land subsidence and shifting ocean currents, the landscape is getting hit from all sides. AFOs that were once merely low-lying are now increasingly at risk of recurrent inundation, while manure storage structures and other pollution control practices at even upland sites will overflow as they are designed to guard against what used to be a 25-year storm.

Against this backdrop, producing poultry at an industrial scale and in a fashion that not only protects local waterways and communities, but actually helps accelerate the restoration of the Chesapeake Bay, will take a herculean effort or, at the very least, an extraordinarily well-designed AFO permit. This is why the undersigned organizations feel this draft permit must be improved. By any measure, this permit is little more than a continuation of the status quo. But the status quo, as described above, is clearly deficient.

II. The Draft Permit Is Not Consistent with the Bay TMDL or the Level of Effort Needed to Ensure the State Meets WIP Commitments.

Given the enormity of the challenge of restoring the Chesapeake, the incredible effort and resources that are being devoted to accelerating progress toward reaching the 2025 Bay TMDL target, and considering the significant percentage of nutrient pollution that is generated by animal feeding operations, it is surprising how little attention is given to the TMDL in this draft permit. Under the Clean Water Act, whenever it is determined that a technology-based effluent limitation is insufficient to ensure attainment of state water quality standards, the permit must include more stringent water quality-based effluent limitations as well.[19] MDE has included such standards in other general and stormwater permits, including the well-known 20% impervious surface restoration standard in the MS4 permits and industrial stormwater general permit.

The EPA Permit Writers Manual for CAFOs says that "[e]ven for CAFOs subject to a no-discharge, technology-based standard for the production area, situations could arise where the permitting authority needs to impose more stringent requirements for allowable discharges. Specifically, *more stringent discharge limitations are necessary in instances where CAFOs discharge from a production area to a*

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[16] Chesapeake Bay Program. Bay News: Bay sees worst dead zone in the past five years. Last accessed December 2019. Available at: https://www.chesapeakebay.net/news/blog/bay_sees_worst_dead_zone_in_the_past_five_years.
[17] Chesapeake Bay Program, Scientific and Technical Advisory Committee. Preliminary Phase 6 Watershed Model (WSM) and Chesapeake Bay Water Quality Sediment Transport Model (WQSTM) Climate Change Assessment Procedures for the 2017 Midpoint Assessment. Last accessed December 2019. Available at: http://www.chesapeake.org/stac/presentations/279_CCAF_STACPeerReviewDocumentation_Draft_063017.pdf.
[18] See *supra* note 16.
[19] 33. U.S.C. 1311(b)(1)(c)

waterbody listed under CWA section 303(d) as impaired due to nutrients, dissolved oxygen or bacteria, or where an analysis of frequency, duration and magnitude of the anticipated discharge (consisting of potential overflows of manure, litter, or process wastewater) indicates the reasonable potential to violate applicable water quality standards." (Emphasis added).

This draft permit includes no such major restoration requirement and makes few references to TMDLs at all. In fact, the draft permit is devoid of any reference to the "water quality standards" that are the basis for federal and state water quality laws. The only references to a TMDL in the draft permit are found in Part VII.K, which merely contains a conclusory statement that "permit requirements *are consistent* with existing Total Maximum Daily Loads (TMDLs) for impaired water bodies" followed by a note that "additional or alternative controls or monitoring *may* be required." (Emphasis added). Similarly, in paragraph K.2. the draft permit states that "consistent with the assumptions and requirements of the Chesapeake Bay TMDL WLA, the Department *may require*, during the permit review process, and at any time after the issuance of the permit coverage, additional BMPs and controls." (Emphasis added).

Currently, the draft permit contains no requirement for identifying nearest waters of the State or their use classes, nor does it require identification of impairments. It is difficult to see how a facility could plan appropriate BMPs to prevent degradation of water quality without such vital information. Without identification of waters of the State or their impairment status, neither the applicant nor MDE, nor the public at large can evaluate whether a facility may impact local water quality or the Bay. Further, the draft permit does not require applicants to identify other AFOs in the subwatershed or immediate area.

As referenced repeatedly in the state's Phase III WIP, the ongoing Bay restoration effort is predicated on an "adaptive management" approach whereby past progress is constantly evaluated and new policies and renewed permits are continually adjusted based on the measured levels of progress. In order to effectuate the adaptive management approach Maryland committed to under the Bay TMDL and referenced repeatedly in the Phase III WIP, **MDE must provide an assessment of the amount of load reductions achieved by permitted AFOs during the current permit term**, including the loads associated with each new BMP established on site, as well as the tonnage of manure exported out of the Bay watershed or to an alternative use facility.

EPA is tasked with monitoring the pace of pollution load reduction progress. In the most recent such evaluation of progress, EPA found that Maryland agriculture "[d]id not achieve its 2017 target for nitrogen, in part, because of missed milestones in the agricultural sector and unexpected changes in agricultural production as reflected in the 2012 Agricultural Census." As a result "EPA expects Maryland to address the nitrogen gap in this sector through increased agricultural BMP implementation."

Unless MDE can provide a detailed justification for the first sentence under Part VII.K declaring that "[p]ermit requirements are consistent with existing Total Maximum Daily Loads" then **the discretionary language that merely authorizes, but does not require, additional BMPs or controls should be removed. We urge MDE to instead build upon the framework established in the current and draft permit around "resource concerns" and "implementation schedules"** that permitted AFOs are required to develop and follow pursuant to III.B. of the draft permit. The current and draft permits provide a useful but currently incomplete process that, with improvement, could serve as a form of water quality-based effluent limit, consistent with the Bay TMDL's assumptions and adaptive management framework and with the scale of additional nutrient and sediment reductions that the Phase III WIP envisions for Maryland's agriculture sector. The draft permit is a critical component of the state's agricultural nutrient reduction strategy under the WIPs and the draft permit should thus be bounded by the Bay TMDL and the commitments the state made under the WIP.

In light of the numerous and overlapping water quality impairments throughout Maryland's portion of the Chesapeake Bay watershed, MDE should determine prior to issuing this permit the extent to which regulated AFOs are causing or contributing to these impairments. Following this evaluation, MDE should revise the draft permit to ensure that these water quality concerns are sufficiently regulated through the existing process of addressing site-specific resource concerns and implementation schedules. The following steps are critical to giving effect to this process of assessing resource concerns, which represents the heart of this pollution prevention permit under the Clean Water Act and the parallel water pollution control regime under state law.

The first step is for the AFO operator and plan writer, in consultation with MDE, to **ensure that any previously identified resource concerns have been adequately addressed and that any practices associated with an implementation schedule have been fulfilled.** The next step is to **identify which additional and relevant conservation practices listed in the NRCS document "Conservation Practices to Address Resource Concerns" for Maryland have not been utilized.**[20] This process of determining additional conservation practices to add to the implementation schedule should be based on site-specific considerations including the number of local impairments, if any, and whether any Tier II waters are located in the same catchment as the AFO, soil test data for the site and any adjacent fields to determine the likelihood of nutrient loss, the number of reported overflows from the site, the presence of any ditches, wells, sinkholes, and proximity to surface waters.

The draft permit should require the operator to fill out a checklist of NRCS conservation practices and any other high priority BMPs identified by the Chesapeake Bay Program as capable of reducing pollution from permitted feeding spaces. This checklist should be returned to MDE as part of the Registration Process described in Part III.C. and the operator should be required to describe which practices were already constructed as part of the implementation schedule associated with the current permit or completed prior to that permit term; the practices that are not relevant; and the additional practices that the operator and/or plan writer determine are necessary to protect water quality and meet state water quality standards. The checklist should include prompts that assist the operator or plan writer in identifying which practices may be relevant and necessary based on site-specific considerations as well as available cost share opportunities. **The draft permit should be amended to reference in IV.A.1.(b) the full checklist of resource concerns identified by the NRCS.**

Importantly, the NOI should not be approved until an MDE permit writer determines whether or not the list of resource concerns is comprehensive and the implementation schedule is reasonable. **We urge MDE to amend the open-ended reference to "a date certain" in III.B.5 and instead include a clear, measurable, and enforceable standard**, such as a deadline of no more than five years from the date of

[20] NRCS. Conservation Practices to Address Resource Concerns. Last accessed December 2019. Available at: https://www.nrcs.usda.gov/wps/portal/nrcs/main/md/technical/cp/.

permit registration to implement most conservation practices identified in the required plan, with longer timelines for specified conservation practices determined by MDE to require additional time for construction.

It must be clear that each AFO covered by this permit is required to implement the appropriate site-specific NRCS conservation practices identified by MDE, the plan writer, and the operator. At a minimum, such practices must be adequate to keep erosion levels in each field at or below the soil loss tolerance value specified in the NRCS Field Office Technical Guide or other relevant standards identified by MDE.[21]

To ensure that this process is rigorous and to avoid what currently appears to be self-regulation by AFO operators, the checklist should be provided on the MDE website alongside each NOI and the public should be given an opportunity to provide comment on whether or not the list of resource concerns is adequate given localized knowledge of environmental conditions. Without MDE review and approval and the opportunity for public comment, the current approach to allowing operators to establish their own list of resource concerns and implementation schedule seems to represent a failure to regulate and certainly would disqualify this framework from serving as a reasonable proxy for a water quality-based effluent limitation. **The draft permit should be amended to require MDE to provide public notice of a 60-day comment period, within 30 days of receipt of either a request for permit coverage, request for renewal, or proposed substantial change to a nutrient management plan.** [22]

At present, the public has no way of understanding what progress permitted AFOs have made toward reducing nutrient pollution in line with the wasteload allocations established in the WIP. The Phase III WIP makes clear that the wastewater and agriculture sectors will be tasked with carrying the bulk of the additional pollution load reduction obligations moving forward. **As the only permitted source of agricultural pollution, AFOs must be given a clear directive regarding the conservation practices expected of them and the public must be given access to information regarding whether the enforceable conditions of these permits are being met.**

Finally, to ensure that this critical permit program is delivering the pollution reductions expected, **the permit should be revised to include references to the availability of funds** available to assist the operator in constructing and installing all necessary conservation practices (including the Maryland Agricultural Cost Share program, Manure Transport Program, and Chesapeake Bay and Atlantic Coastal Bays 2010 Trust Fund, among other programs).

[21] NRDC, *Sample State Pollution Control Permit,* available at https://www.nrdc.org/sites/default/files/cafos-dont-know-hurting-us-sample-permit.pdf

[22] MDE may determine that any change to the NMP is substantial based on the proposal to change the NMP. At minimum, any of the following changes should constitute a substantial change to the NMP: 1. Any increase in animal numbers above the number specified in the application for permit coverage. 2. Addition of new land application areas not previously included in the AFO/CAFO's NMP, except if the added land application area is covered by the NMP incorporated into an existing NPDES permit and the AFO/CAFO complies with the NMP when applying manure, litter, and process wastewater to the added land. 3. Changes to the maximum amounts of nitrogen and phosphorus derived from all sources for each crop. 4. Changes to site-specific components of the AFO/ CAFO's NMP, where such changes may increase the risk of nitrogen and phosphorus transport to Waters of the State. 5. A change in the type of manure system. 6. Adding new treatment technologies to existing treatment systems. See NRDC, *Sample State Pollution Control Permit,* available at https://www.nrdc.org/sites/default/files/cafos-dont-know-hurting-us-sample-permit.pdf

Maryland's wastewater sector has delivered the vast majority of nutrient reductions in the past and that progress was only made possible as a result of substantial support from state capital funds. In a similar fashion, the AFO permit cannot be expected to deliver the substantial reductions needed without substantial funding support from state programs and from contributions from the poultry integrators. AFO operators deserve to understand this context and the different programs available to support their efforts. Similarly, the public deserves to know that the commitments Maryland made in the WIP are not hollow but will be upheld through this key permit.

The AFO permit does not exist in a vacuum, but is a part of a larger policy framework geared toward delivering extraordinarily cost effective pollution reductions. This draft permit is perhaps the most important permit in Maryland. MDE must protect the integrity of the TMDL and follow through on the Bay commitments made to Marylanders by incorporating key water quality-based effluent limitations and Bay restoration requirements into this permit.

Several commenters attempted to obtain documents, data, records, and other information from MDE regarding the TMDL determinations in the permit. Pursuant to state law, Public Information Act ("PIA") requests were sent to MDE's Land Management Administration (LMA) with explicit and specific requests for documents related to TMDL implementation and determinations. This PIA request was submitted to MDE October 4, 2019. We followed up numerous times between then and the submission date of this comment. **To date, MDE has not provided the Parties with any documents responsive to the TMDL section of the 10/4/2019 PIA request. Furthermore, contrary to State law, MDE has not provided the Parties with a statement or explanation as to why the requested documents are either exempt from disclosure or do not exist.**[23] MDE's failure significantly harms the commenters' ability to provide public comments to MDE regarding this permit, harms our ability to participate in a public permitting process and is an infringement of due process rights to public participation and access to information.

III. Maintaining Existing Permit Conditions is Not Sufficient to Protect Water Quality in the Face of a Changing Climate.

On the Eastern Shore of Maryland, as much as anywhere in the United States, the impact of a changing climate is clear for anyone to see. With islands disappearing, salt water forcing the abandonment of thousands of acres of agricultural lands, and "25-year storms" inundating vast expanses of floodplains far more often than once every 25 years, the state must act with urgency to update and modernize policies to be reflective of current and future conditions. We urge MDE to reissue the draft permit with climate reforms and considerations.

Again, several commenters attempted to obtain documents, data, records, and other information from MDE regarding climatological and meteorological information that was considered and reviewed by MDE during the drafting of the Permit. A PIA request was sent to MDE LMA on October 4th 2019 with a clear and explicit request for this information. To date MDE has not provided documents responsive to this request or provided an explanation regarding why the requested documents have not been produced. Not only is the lack of response in violation of the law but MDE's failure to produce this information harms the

[23] Maryland Public Information Act. Md. Code Ann., Gen Provis. § 4-202

commenters' ability to fully participate in the public permitting process. MDE has preemptively and without reason foreclosed public discussion of how the Permit's ability to protect state waters is impacted by the unique and specific climate threats facing Maryland.

a. Maryland must consider climatic and precipitation conditions in designing the TBELs for stormwater discharges

The premise of this no discharge permit is that the proper design and implementation of onsite BMPs will eliminate actual discharges to surface waters as well as the potential to discharge from the site. These BMPs serve as technology based effluent limitations (TBELs) that are necessary for an operation to comply with the zero discharge requirements of this permit and with federal regulations. However, there is no indication that the required BMPs are designed to adequately control the increasingly extreme precipitation events occurring in Maryland. The increased threat of extreme rain events in Maryland must be part of MDE's consideration and design of this draft permit. It is not sufficient to rely on outdated standards when the science is clear that Maryland and the Mid-Atlantic are experiencing extreme rain events at a greater frequency than any other part of the contiguous United States.

All nine of the minimum standards contained in the permit at Part IV.B. of the permit must be re-examined in light of current and project precipitation trends in Maryland. The majority of these minimum standards are carryovers from previous permit iterations and therefore based on older data that may lack information about current trends and projections for extreme rain events.

b. Maryland should require all permit applicants and permit-holders to respond to present-day flood risks and precipitation conditions.

Climate change has already increased the risk of flooding and the intensity and volume of precipitation in Maryland. Therefore, MDE should require all permit applicants to identify and consider present-day flood risks and precipitation conditions at their facilities in applications for permit coverage and in the design and maintenance of stormwater control practices. **MDE should also require permittees to document and report all flooding incidents** that impact the production area (regardless of whether inundation or an overflow occurred) to regulators in order to gather data on site-specific flood risks and all potential pollution discharges.

At present rates of sea level rise, the Lower Eastern Shore is losing about 100 acres per year of productive land to saltwater intrusion according to University of Maryland researchers.[24] And the pace of sea level rise is expected to increase dramatically. According to NOAA tide gauges, sea levels have risen about 13 inches over the last 100 years, while according to the Maryland WIP, the average projection is for another 3.7 feet in the next 80 years, or four times more sea level rise per year, on average. In fact, the pace of inundation could actually be far worse in some areas. A vulnerability assessment of the Eastern Shore conducted by the Eastern Shore Land Conservancy, the Eastern Shore Regional GIS Cooperative (ESRGC), the Georgetown Climate Center, and the University of Maryland Environmental Finance Center and based on

[24] See Bay Journal article "Saltwater intrusion laying waste to Delmarva farms as sea level rises" by Jeremy Cox. Last accessed December 2019. Available at: https://www.bayjournal.com/article/saltwater_intrusion_laying_waste_to_delmarva_farms_as_sea_level_rises.

work conducted by the U.S. Army Corps of Engineers assumes that sea levels will rise by 2 feet by 2050 and 6 feet by 2100.[25] So, while 100 acres may be lost per year now to saltwater, this may snowball to many hundreds or thousands of acres lost in future years.

Based on the enormous financial losses to the Eastern Shore that the Eastern Shore Land Conservancy and its partners are projecting from sea level rise and storm surge inundation, those groups recommended, among other items: (1) conducting a resilience assessment prior to undertaking capital investments; (2) expanding the regulatory floodplain; (3) enacting a three-foot freeboard requirement in building codes; and (4) regulating certain flood zones as if they are in a higher risk coastal flood zone now (to make sure that we're preparing for future risks now).[26]

The Phase III WIP also acknowledges that "more intense storms are expected to change the effectiveness of BMPs to control pollution runoff." The WIP states that "[t]hese enormous costs are raising questions, nationally and in Maryland, whether building and rebuilding should continue in areas with repeat catastrophic weather events. As the State continues to invest in BMPs to restore the Bay, it must carefully consider their placement to avoid areas that are at risk from the most severe climate impacts." The writers of the WIP, including many MDE staff that contributed to writing it, identified a number of reasons why doing nothing will force the state to incur additional costs later:

> "First, increasingly frequent and severe extreme weather events will damage BMPs and necessitate more inspections, maintenance, or replacement. Second, more BMPs need to be installed to compensate for an anticipated loss of BMP pollution reduction efficiency. Third, additional BMPs are likely needed to address increased future pollution loads."

Given the increasing likelihood of flooding to permitted facilities and the potential risk of flood-induced pollution discharges, MDE should revise the draft permit's reporting requirements in order to capture data for every incident of flooding that occurs at a permitted facility.[27] An all-encompassing requirement for reporting flooding incidents at permitted sites will be beneficial to permittees and MDE in a number of ways. First, the requirement would ensure that any episode of potential flood-induced discharges is documented. Second, the documentation and reporting would also benefit the permittee and agency by providing site-specific flood data that could help with the design and implementation of future flood-mitigation measures. Lastly, the collection of this data would allow Maryland to begin creating a record of flooding to support future permit-wide adaptation reforms.

c. Maryland should reject applications for new CAFO facilities at risk from inundation.

Section IV.E. of the draft permit must be strengthened. It is imperative for the protection of waters of the State that MDE establish siting standards to keep new facilities and their appurtenant infrastructure out of

[25] Eastern Shore Land Conservancy on behalf of the Eastern Shore Climate Adaptation Partnership. Mainstreaming Sea Level Rise Preparedness in Local Planning and Policy on Maryland's Eastern Shore. Last accessed December 2019. Available at: http://www.eslc.org/wp-content/uploads/docs/coastal-resilience/regional-sea-level-rise-study-2019.pdf.
[26] *Id.*
[27] A number of provisions may already require reporting of some, but not all, flood incidents at permitted sites. Submittal of required plans, Part III.B.; Annual implementation report, Part V.B.; Notification of noncompliance, Part V.E.; Notification of upset, Part V.F.; Notification of Emergency or Catastrophic Loss, Part IV.F.6.

areas of high risk of inundation now or under future climate conditions. Currently, MDE has approved facilities that have expanded their operations within a floodplain, while adjacent houses on site have been decommissioned due to flooding damage. At a minimum, **we strongly urge MDE to prohibit new and expanded AFOs from being sited in a FEMA flood zone (areas not determined to be an area of minimal flood hazard), in areas subject to potential inundation by storm surge from a Category 1 or 2 hurricane, and areas projected to be at risk of inundation from storm surge when sea levels increase by two feet or less.**

d. Maryland should consider revisions to the draft permit and future modifications to the reissued permit to account for forthcoming studies and planning processes.

MDE should revise the draft permit to include a reopener clause, committing to modify the permit to address forthcoming climate change analyses, reports, and plans relevant to this permit. Critically, MDE should ensure that reasonable modifications are made to this permit no later than 2022 for the purpose of incorporating the state's commitment to address climate-attributable pollution loads to the Chesapeake Bay as part of the Bay TMDL mid-point assessment.

Maryland committed to submit to EPA an addendum to its Phase III WIP that addresses previously unaccounted for loads of pollution attributable to climate change. Preliminary modeling of these loads by the Bay Program indicates that Maryland's share could amount to 2.19 million pounds of nitrogen per year by 2025 that are not currently accounted for by the state's WIP or in existing permitting programs. Maryland's climate addendum is due for submission in 2021, which is several years before this permit will expire. The climate addendum is likely to consider new and revised commitments relevant to agricultural sources of climate-attributable pollution, including, for example, potential increases in agricultural stormwater discharges attributed to increasing intensity and quantity of precipitation within the region.[28] Maryland will soon also finalize several relevant climate studies, reports, and plans including, for example, a statewide plan to address nuisance flooding, a statewide plan to address saltwater intrusion, an update to Maryland's modeling and mapping of 100-year flood-zones, and a Commission on Climate Change report on the impact of climate change to Maryland agriculture.[29]

e. Maryland should impose on-site manure management practices that mitigate growing greenhouse gas emissions from the industrial agricultural sector.

Clean Water Act permits are not regulatory instruments primarily designed for controlling air emissions. However, as Maryland has acknowledged in the past, thoughtfully designed stormwater management, including basic housekeeping practices, have the potential to produce co-benefits, among them, reducing greenhouse gas emissions, particulate matter, and other air pollution.[30] Maryland should consider existing

[28] Notably, in its Phase III Watershed Implementation Plan, Maryland specifically commits to continued research on the impact of increased precipitation on stormwater BMP performance, which would support the modification of stormwater design standards and other elements of this permit to account for the impacts of climate change.
[29] The MCCC report on the impact of climate change to Maryland agriculture was due to the Commission in early 2019. As of 12/19/2019, the STWG had not released the report or a draft report.
[30] "Operators must minimize generation of dust and off-site tracking of raw, final or waste materials. Dust control practices can reduce the activities and air movement that cause dust to be generated. Airborne particles pose a dual threat to the environment and human health. Dust carried off site increases the likelihood of water pollution." Maryland

research on greenhouse gas and other toxic air emissions from animal manure in setting requirements for on-site manure management practices, including, for example, thresholds and requirements for the quantity, duration, and containment practices for manure stockpiles. The NRCS standards include several practices related to greenhouse gas emissions and offer viable and thoroughly tested solutions designed specifically for AFOs or other agricultural producers.[31]

One third of nitrogen pollution to the Bay occurs through air deposition of pollutants.[32] While some forms of nitrogen-based emissions have declined, emissions of ammonia and nitrous oxide have increased along with the quantity of animal manure produced. Nitrous oxide is a highly persistent greenhouse gas that is 300 times more potent than carbon dioxide.[33] Nearly three-quarters of the nitrous oxide emitted in the United States is attributed to the agricultural sector and emissions are increasing along with the expansion of industrial animal agriculture.[34] When manure is stockpiled in large quantities nitrous oxide is produced and emitted, along with the potent greenhouse gas methane. Recent research also shows that for each unit of fertilizer applied, soils produce between 1% to 5% nitrous oxide (by weight). When fertilizer is applied in excess of crop needs, the increase in nitrous oxide production is exponential. These studies suggest that manure management practices could be tailored to mitigate substantial emissions.[35]

In a recent report, the Environmental Integrity Project estimated that a typical Eastern Shore CAFO – producing some 500,000 chickens annually – could produce up to 24 tons of ammonia per year, nearly double the previous estimate by EPA Bay regulators.[36] Researchers attribute this higher estimate, in part, to such management practices as high-frequency reuse of bedding materials and to warmer climate conditions. While ammonia's contributions to climate change may be minimal compared to nitrous oxide, methane, or carbon dioxide, it is a potent occupational and public health threat, especially for AFO workers and for vulnerable communities adjacent and downwind of CAFOs and other industrial agriculture facilities.

During the period of this permit, Maryland should commit to a review of the literature and consultation with researchers and other experts to devise technical requirements for manure management that reduce the potential for emission of greenhouse gases and other toxic air pollutants.[37] **Maryland should incorporate**

Department of Environment, 12-SW - Fact Sheet for General Permit for Stormwater Discharges Associated with Industrial Activity (Oct., 2012, updated Oct., 2013), at pg. 36. Available at: https://mde.maryland.gov/programs/Permits/WaterManagementPermits/Documents/GDP%20Stormwater/12_SW_FactSheet_Final.pdf.

[31] See supra note 20.

[32] See U.S. EPA, Chesapeake Bay Total Maximum Daily Load for Nitrogen, Phosphorus and Sediment, Appendix L, page L-2 (Dec. 29, 2010)

[33] For more, see Sabrina Shankman, What Is Nitrous Oxide and Why Is It a Climate Threat?, Inside Climate News (Sept. 11, 2019). Available at https://insideclimatenews.org/news/11092019/nitrous-oxide-climate-pollutant-explainer-greenhouse-gas-agriculture-livestock.

[34] Thompson, R.L., Lassaletta, L., Patra, P.K. et al. Acceleration of global N2O emissions seen from two decades of atmospheric inversion. Nat. Clim. Chang. 9, 993–998 (2019) doi:10.1038/s41558-019-0613-7.

[35] Iurii Shcherbak, Neville Millar, G. Philip Robertson, Global metaanalysis of N2O fertilizer responses, Proceedings of the National Academy of Sciences Jun 2014, 111 (25) 9199-9204; DOI: 10.1073/pnas.1322434111.

[36] Abel Russ and Eric Schaeffer, Ammonia Emissions from Broiler Operations Higher than Previously Thought, Environmental Integrity Project (Dec. 2017). Available at: https://www.environmentalintegrity.org/wp-content/uploads/2017/12/Ammonia-Emissions.pdf.

[37] See generally, Hongmin Dong, et al, Chapter 10: Emissions from Livestock and Manure Management, in 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4 Agriculture, Forestry, and Other Land Use.

revisions to manure management requirements in the proposed permit through a permit modification.

IV. New Language in the Draft Permit Regarding Air Pollution is Inadequate in Light of the Magnitude of Nutrient Pollution Emitted by AFOs

Ammonia from U.S. poultry operations and, in particular, broiler operations have been widely studied over the past fifteen years.[38] Estimates of emissions factors are relatively consistent in Delmarva and range from 0.47 grams of ammonia per bird per day (g NH_3 $bird^{-1}$ day^{-1}) to 0.98 g NH_3 $bird^{-1}$ day^{-1}.[39] EPA's 2004 National Emissions Inventory Draft Report on Ammonia Emissions calculated a broiler emissions factor of 0.22 pounds per bird per year.[40] Recently, EPA provided emissions rates for ammonia emissions from poultry operations for the purpose of reporting air releases pursuant to federal requirements.[41] The rates provide a range of industry practices, including the number of days per flock (40 to 63) and whether the litter is reused for subsequent flock or new bedding.

These averages contemplate the fluctuations in ammonia emissions driven by factors such as broiler age, type and amount of feed, temperature, and frequency of tunnel house cleanouts and litter changes. It is also worth noting that a 2004 study by Siefert *et al* characterized AFOs on Delmarva, finding some of the highest emissions rates of any such study in the U.S., with an emissions rate of 1.18 grams of ammonia, per bird, per day (g NH3 bird-1 day-1). This study, as well as the EPA 2004 National Emissions Inventory data, were relied on for a 2010 study by the Maryland Department of Natural Resources (DNR) on broiler ammonia

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https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_10_Ch10_Livestock.pdf; Paul Jun, Michael Gibbs, and Kathryn Gaffney, CH4 and N2O Emissions from Livestock Manure, in 2002 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. https://www.ipcc-nggip.iges.or.jp/public/gp/bgp/4_2_CH4_and_N2O_Livestock_Manure.pdf; IPCC, Chapter 4: Agriculture, in 2000 IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. https://www.ipcc-nggip.iges.or.jp/public/gp/english/4_Agriculture.pdf; and Gerber, P.J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., Falcucci, A. & Tempio, G. 2013. Tackling climate change through livestock – A global assessment of emissions and mitigation opportunities. Food and Agriculture Organization of the United Nations (FAO), Rome.

[38] Burns, R. T., K. A. Armstrong, F. R. Walker, C. J. Richards, and D.R. Raman. 2003. Ammonia emissions from a broiler production facility in the United States. In Proc. International Symposium on Gaseous and Odor Emissions from Animal Production Facilities, 88-95. Horsens, Denmark: CIGR.
See also Lacey, R. E., J. S. Redwine, and C. B. Parnell, Jr. 2003. Particulate matter and ammonia emission factors for tunnel-ventilated broiler production houses in the southern U.S. Trans. ASAE 46(4): 1203-1214.
See also Siefert, R. L., J. R. Scudlark, A. G. Potter, K. A. Simonsen and K.B. Savidge. 2004. Characterization of atmospheric ammonia emission from a commercial chicken house on the Delmarva Peninsula. Environ. Sci. Tech. 38(10): 2769:2778.
See also Wheeler, E.F., et al. Ammonia Emissions from Twelve U.S. Broiler Chicken Houses. Agricultural and Biosystems Engineering Publications (2006). Paper 151. Available at http://lib.dr.iastate.edu/abe_eng_pubs/151. Ammonia Emissions from Broiler Houses_ J Appl Poult Res-2005-Pescatore-635-7.
See also EPA: National Emission Inventory—Ammonia Emissions from Animal Husbandry Operations. January 30, 2004 Draft Report.

[39] Broiler Industry Ammonia Emissions in the Chesapeake Bay Watershed. 2010 Report by Maryland Dept. of Natural Resources: DNR 12-6232010-459; PPRP-154.

[40] EPA: National Emission Inventory—Ammonia Emissions from Animal Husbandry Operations. January 30, 2004 Draft Report. at 35, 56, 90, 123. EPA data and methodology at 31-35, table 3-8 at 35, and App.D.3.3 – table D-12 at 123. EPA's 0.22 lb. NH3 bird-1 year-1 estimate contemplates 5.5 flocks, with flock age ranging from 45-60 days.

[41] EPA: CERCLA and EPCRA Reporting Requirements for Air Releases of Hazardous Substances from Animal Waste at Farms: Ammonia and Hydrogen Sulfide Emission Rates for Poultry Operations. Last accessed December 2019. Available at: https://www.epa.gov/epcra/cercla-and-epcra-reporting-requirements-air-releases-hazardous-substances-animal-waste-farms.

emissions in Maryland. That study found that between 1990 and 2006 the Maryland poultry industry emitted over 30,000 tons of ammonia per year, based on EPA emissions factors.[42] [43]

A conservative, or low, emission factor could be derived from EPA's emissions rate guide for AFO reporting, of 0.59 g NH_3 $bird^{-1}$ day^{-1}. A typical new broiler operation in Maryland cycles through approximately 6.8 flocks per year, at 36 days per flock, or 244 days per year.[44] Recent reporting from the Delmarva Poultry Industry for 2017 estimates 306.7 million broilers were raised in Maryland, producing 1.84 billion pounds of meat. Conservatively, with a state capacity of about 50 million chickens, *at least* 15 million pounds of ammonia would be emitted from poultry houses each year. This estimate ***does not*** include emissions from house cleanouts, flock removal, windrowing practices or manure storage.

Once ammonia is emitted, it travels through the atmosphere, with much of it re-depositing on land or water surfaces near the source. One recent study estimated that 40% of emitted ammonia re-deposits with 2.5 km of the source, and 70% re-deposits within 50 km of the source.[45] Once ammonia deposits on land, it undergoes chemical transformations, some of the nitrogen is absorbed by growing crops or other plants, and some of the nitrogen makes its way to the Chesapeake Bay and Atlantic Coastal Bays.

Even the most conservative estimates of both ammonia emissions and dispersal, and nitrogen deposition with the Bay watershed represent a substantial contribution of nitrogen not only to local lands and waterways, but to the Bay watershed's tidal estuaries and coastal estuaries of the Eastern Shore. As discussed above, nitrogen is sourced from all stages of the life cycle of poultry waste, namely, volatilization within poultry houses, volatilization and leachate from manure storage sheds, and volatilization and leachate during transport, field storage and field application. **It is imperative that the draft permit address those sources entirely under the regulatory scope of this draft permit.**

As discussed in Part II, above, the draft permit must ensure compliance with the Bay TMDL. Failure to account for significant and substantial nitrogen inputs to waters of the State and ultimately the Bay is a failure to meet CWA requirements. Beyond federal requirements, as listed in 40 CFR 12.42(e), the previous iteration of the permit and the instant draft permit require protections concerning waste storage, recordkeeping and controlling nutrient loss, pursuant to Part IV. Special Conditions. Part IV.A.1.a. states:

> a) The required plan shall take into account all animal manure, chicken litter, or process wastewater associated with animal production, regardless of the source of the animal manure, chicken litter, or process wastewater. The plans shall ensure that appropriate manure management measures are used to store, stockpile, and handle animal manure and waste nutrients associated with animal production to

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[42] DNR Report 2010, at 11-13.
[43] Environmental Integrity Project, Ammonia Emissions from Broiler Operations Higher than Previously Thought (Jan. 2018), available at https://www.environmentalintegrity.org/reports/ammonia-emissions/.
[44] University of Maryland Extension. Broiler Production Management For Potential and Existing Growers. 2016. Last accessed December 2019. Available at: https://extension.umd.edu/sites/extension.umd.edu/files/_docs/Broiler%20Production%20Management%202016.pdf.
[45] J. Baker et al., Modeling and Measurements of Ammonia from Poultry operations: Their Emissions, Transport, and Deposition in the Chesapeake Bay, Sci. Tot. Environ, online pre-proof at pages 23-24 (Nov. 24, 2019), https://www.sciencedirect.com/science/article/pii/S0048969719352829.

minimize the potential for nutrient loss or runoff. The manure management requirements shall encompass all land where animals are kept and all land used for manure storage, treatment, or utilization that is under the control of the permittee.

Because nutrient loss occurs throughout the life cycle of waste production, storage, transport and application, the foregoing paragraph requires that applicants account for and manage the enormous amounts of ammonia produced from each poultry house and manure storage shed, while it remains in the production area. Similarly, Part IV.B.6 requires minimum setbacks from waters of the State for stored poultry, in order to control nutrient loss, and Part IV.B.8 requires similar setbacks for land application of manure and wastewater. Finally, Parts IV.A. & IV.B.9 requires records be kept for "animal manure and waste nutrient associated with animal production… ." Without minimum accounting of and controls for ammonia-nitrogen from both poultry houses, manure storage areas, and land application practices, hundreds of thousands of pounds of nitrogen will continue to be discharged into waters of the State from these facilities.

The only reference the draft permit makes to the substantial ammonia pollution caused by AFOs is new language in Part IV.D. that advises, but does not require, an operator to "use appropriate NRCS conservation Practice Standards to address the concern" if "outdoor air quality is determined to be a resource concern." Once again, the framework for determining whether or not something is a resource concern is left up to the owner or operator of the regulated AFO. As such, there are no pollution limits or standards in the draft permit capable of protecting waters of the State, AFO workers, or downwind communities from the massive amount of ammonia emitted by large poultry AFOs, as well as potentially hazardous amounts of particulate matter or any other pollutant.[46]

V. The Draft Permit's Use of the Term "Discharge" is Inconsistent and Problematic

The scope and importance of the term "discharge" under the Clean Water Act has been the subject of litigation and considerable debate both within and outside the context of AFO permitting and regulation. Federal CAFO regulations and Maryland's current and draft permit are often described as relying on a "no discharge" standard. But this legal fiction is neither helpful in attempting to address the environmental implications of AFOs, nor, arguably is the term legally relevant and consistent with the framework of laws regulating pollutants from AFOs in Maryland. **For the following reasons, we urge MDE to remove references to "no discharge."**

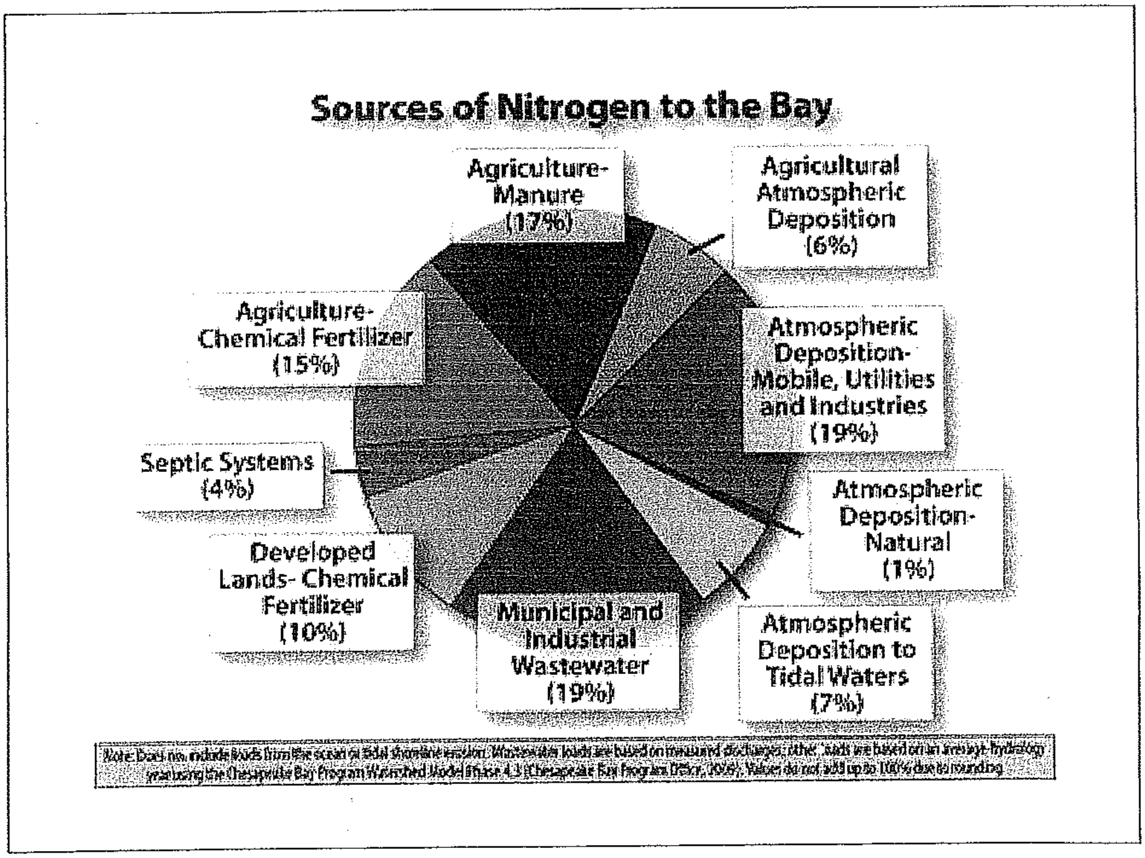
The draft permit inserts a definition of "discharge" that is absent in the current permit. The term "discharge" is appropriately defined consistent with the definition used elsewhere in state law as "(a) the addition, introduction, leaking, spilling, or emitting of any pollutant to waters of this State; or (b) the placing of a pollutant in a location where the pollutant is likely to pollute." This definition is far broader in scope than the much litigated definition of discharge under the Clean Water Act. Because the state definition of "discharge" is substantially different than the federal definition it is irrational to copy and paste references to federal standards such as the "no discharge" presumption within the state permit. Specifically, under the state's broad definition, if we are to presume that an AFO does not "discharge" we would be forced to

[46] NRCS National Planning Procedure Handbook, Section 600.54(a)(2)(i) - Element Criteria for CNMP Development, specifically identifies ammonia emissions as a source of pollution deposited to surface waters.

APPENDIX 4, EXHIBIT B

Maryland's Phase II Watershed Implementation Plan,
Appendix A: Sources of Nitrogen to the Bay

Relative Responsibility for Loads to the Bay



Data source: Chesapeake Bay Program Watershed Model P5.3_Loads-Acres_07302010 files for 1985 No Action compared to 2009 progress run.

APPENDIX 4, EXHIBIT C

Baker J, Battye WH, Robarge W, Pal Arya S, Aneja VP. ***Modeling and measurements of ammonia from poultry operations: Their emissions, transport, and deposition in the Chesapeake Bay.*** **Sci Total Environ. 2020 Mar 1; 706:135290.**
(R. at 0485 n.45)

This exhibit includes several sections of the leading study on ammonia deposition estimations on Maryland's eastern shore. It demonstrates both the quantities of ammonia deposited onto the Eastern Shore, as well as the percent of total emissions deposited in a given distance from a CAFO, as discussed in the Administrative Record on pages 484 to 486 and cited in footnote 45 and referenced in the memorandum of law at pages 3, 9, 10, 23 and 24.

For the full report see:
https://www.sciencedirect.com/science/article/pii/S004896971935
2829.

Modeling and Measurements of Ammonia from Poultry Operations: Their Emissions, Transport, and Deposition in the Chesapeake Bay

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ABSTRACT

The goal of this study is to determine how much ammonia/nitrogen is being deposited to the Maryland Eastern Shore land and the Chesapeake Bay from poultry operations on Maryland's Eastern Shore. We simulated the fate of ammonia/nitrogen emitted (using emission factors from the U.S. EPA in conjunction with Carnegie-Mellon University) from 603 poultry facilities using the air quality model, AERMOD. The model domain was approximately 134 km by 230 km (and covers the full land area of Maryland's Eastern Shore), with a horizontal resolution of 2 km by 2 km. Ammonia concentration observations were made at 23 sites across Maryland's Eastern Shore during two periods (September and October 2017) in order to calibrate the model. An ammonia deposition velocity of 2.4 cm/sec was selected based on the sensitivity analysis of results for the simulation of a large poultry facility, and this value fell within the range of measurements reported in the scientific literature downwind of Concentrated Animal Feeding Operations (CAFOs). The ammonia deposition velocity of 2.4 cm/s leads to an estimated total annual ammonia deposition of 11,100 Megagrams/year (10,600 Mg/yr deposition to land, and 508 Mg/yr deposition to water (1Mg = 1,000,000g = 1.1023 US Tons)). In addition, model simulations indicate that ~72.4% of ammonia emissions from poultry animal feeding operations would be deposited within the modeling domain. However, this deposited ammonia/nitrogen may be transported through waterways from the land mass and ground water to the Chesapeake Bay. A comprehensive sensitivity analysis of the assumed ammonia deposition velocity (ranging from 0.15 to 3.0 cm/s) on estimated ammonia annual deposition is provided. Using the lower limit of an ammonia deposition velocity of 0.15 cm/s gives much smaller estimated total annual ammonia deposition of 2,040 Mg/yr (1,880 Mg/yr deposition to land and 163 Mg/yr deposition to water).

1.0 Introduction and Background

The Chesapeake Bay is the nation's largest estuary, but like many waterbodies in the U.S. it is plagued with poor water quality due to excess loads of nitrogen and phosphorus (Sheeder et al., 2002; U.S. EPA, 2010, Da et al., 2018). These excess nutrients cause algal blooms that reduce water clarity, contribute to the Bay's dead zone i.e. areas in the Bay and its tidal rivers with insufficient levels of dissolved oxygen, and drinking water concerns (Boesch et al., 2001; US EPA, 2011; Linker et al., 2013; Beachley et al., 2019; and Walker and Beachley, 2019). Because of these water quality problems, in 2010 the U.S. Environmental Protection Agency (EPA) worked with the six Bay states and the District of Columbia to develop the Chesapeake Bay Total Maximum Daily Load that requires significant reductions in nitrogen, phosphorus and sediment in order to meet water quality standards (US EPA, 2010). Roughly one-third of the nitrogen entering the Bay and its tidal rivers comes from atmospheric deposition, and recent estimates indicate roughly one-half of this is due to ammonia (Paerl et al., 2002: Linker et al., 2013). The main source of this ammonia is animal operations (Aneja et al., 2001; Bittman and Mikkelsen, 2009; Battye et al, 2017).

Although agricultural production is widespread throughout the Chesapeake watershed, there are three major animal production regions with the greatest concentrations of animals: the Lower Susquehanna River in Pennsylvania, the Shenandoah Valley in Virginia and West Virginia, and the Delmarva Peninsula in Delaware, Maryland, and Virginia (Figure 1). The Delmarva Peninsula is dominated by integrated poultry (mostly broilers) production (Figure 3).

To determine transport, dispersion, and deposition of emitted ammonia requires air quality modeling. Emitted pollutants in the atmosphere are transported by winds and dispersed by turbulent fluctuations in all directions (Aneja et al., 2001; National Research Council, 2003;

Yao et al., 2018). Energy exchanges at the earth's surface influence the planetary boundary layer (PBL) height and turbulent exchanges of momentum, heat and mass (pollutants), thus carrying the pollutants to large horizontal distances and spreading them through the depth of the PBL (Arya, 1999). Model simulated ground -level concentrations (GLC) and deposition of ammonia are analyzed to evaluate their impacts to sensitive ecosystems such as the waterways and the Chesapeake Bay. The objective of this study is to estimate the deposition of ammonia/nitrogen (the "nitrogen" signifies that the parameter is expressed based on mass of N) to the Chesapeake Bay and adjacent lands from poultry animal feeding operations (AFOs) located on the Maryland Eastern Shore (yellow region in Figure 1).

1.1 Emission Factors

The U.S. EPA has been working with Carnegie-Mellon University (CMU) to develop NH_3 emission factors that take into account local meteorological conditions at the county level (these are referred to as EPA/CMU emission factors). More recently, EPA and CMU have produced a Farm Emission Model (FEM), which takes into account meteorological conditions and potential emission control practices, such as the addition of aluminum sulfate to poultry waste (McQuilling et al, 2015). Each emission factor or emission model covers three components that contribute to the total emission factor: (1) Confinement refers to the emission from animals residing inside of a Confined Animal Feeding Operation (CAFO) and emission from the waste produced within the contained area; (2) Storage refers to the emission of ammonia/nitrogen from the storage of the waste removed from the CAFO; (3) Land application, as implied, is the emission of ammonia/nitrogen after waste is applied to a field as fertilizer. The total emission factor is the sum of confinement, storage, and land application. We assume that farms in the study region generally do not use waste management amendments, such as aluminum sulfate, and that the farms store and apply waste in the vicinity of the original confinement area.

Ammonia emission factors are subject to considerable variability and uncertainty. Previous studies give emission factors as high as 0.789 kg NH_3 per bird per year (Gates et al., 2005), and as low as 0.035 kg NH_3 per bird per year (Burns et al., 2007). We have adopted an emission factor of 0.20 kg NH_3 per animal per year which is the average annual emission factor developed by CMU and EPA for the counties in the study region. This factor is a composite of emission factors for broiling chickens and laying chickens, with broilers accounting for about 90% of poultry emissions in the region. McQuilling et al (2015) have calculated the mean fractional error of the CMU/EPA FEM currently used to estimate animal emission factors, at 69% based on comparison with measurements at broiler operations.

1.2 Fate of Atmospheric Ammonia/Nitrogen

At the earth's surface, NH_x (= ammonia (NH_3) + ammonium (NH_4^+)) has a range of beneficial and detrimental consequences for humans and the environment (Tomich et al., 2016; Battye et al., 2017). For example, nitrogen fertilizers have had a beneficial effect on agriculture globally by increasing crop yields. However, the high loading of reactive nitrogen (reactive nitrogen includes all biologically active, chemically reactive, and radiatively active nitrogen compounds in the atmosphere and biosphere of the earth, in contrast to non-reactive gaseous dinitrogen (N_2)), has led to deleterious effects on the environment, such as acidification of soils, forest decline, decreased visibility from increased aerosol production, and elevated nitrogen (both ammonia/nitrogen and oxides of nitrogen (NO_x)) concentrations in ground and surface waters, possibly leading to enhanced eutrophication in downwind ecosystems (Asman et al., 1998; Aneja et al., 1998; Krupa, 2003; Baek and Aneja 2004). Thus, there is a need to study the

NH_x deposition changes, spatial distribution, and transport of ammonia from agricultural sources (both crop and animal) to gain a better understanding of effective means to control or reduce excess amounts of ammonia and ammonium deposition.

Any atmospheric ammonia that is not dry deposited or scavenged by raindrops is converted into atmospheric ammonium (Seinfeld and Pandis, 2016). This is done through the interaction of gaseous ammonia with small water particles not large enough to effectively dissolve gaseous ammonia. The conversion of ammonia to atmospheric ammonium (NH_4^+) is important because the ammonium aerosol has a much longer lifetime than ammonia and is an alkaline species that is readily used in the process of $PM_{2.5}$ formation, especially in the presence of sulfuric acid and nitric acid (Jacobson, 1999; Baek and Aneja, 2004; Paulot and Jacob, 2013).

Dry deposition is another process which is important to understand the fate of atmospheric ammonia. Depending on an area's temperature, humidity, and precipitation, dry deposition may be the largest contributor to nitrogen deposition from ammonia releases (Duyzer, 1994). Dry deposition refers to the removal of atmospheric gases or particles without the presence of moisture in the atmosphere. Given that ammonia is highly soluble, it is important to consider dry deposition to both vegetation and to water bodies. Water bodies on which ammonia is deposited can cause dissolution of ammonia and lead to an additional nitrogen deposition mechanism (Larsen et al., 2001). With no natural surface resistance due to the solubility of the species, ammonia uptake by water bodies is efficient and is an important factor in areas where wetlands, rivers, lakes, or other large ocean bodies are present (Larsen et al., 2001). This fact coupled with the concentration of emission sources on the Delmarva Peninsula makes dry deposition a vital topic of this study.

Deposition of ammonia/nitrogen to water and land surfaces with vegetation is expressed using a resistance model approach. When expressing deposition to vegetation, atmospheric gases encounter several factors (resistances) influencing their deposition fluxes. These are aerodynamic resistance (r_a), quasi-laminar resistance (r_b), and surface resistance (r_c). The resistance of gases to transport from the atmosphere to the surface is r_a. Once a gas molecule makes it to the surface for exchange, it must overcome resistances to molecular diffusion across the quasi-laminar boundary layer of air at the leaf surface (r_b) and uptake to the surface (canopy) itself. The r_c is determined by the characteristics of the surface (e.g., presence of moisture, acidity of the surface, leaf stomatal processes) to which the gas is depositing. There are separate resistances that make up r_c, which include water resistance, ground resistance, and foliar resistance. Typically, a vegetative canopy exists which involves additional complex resistances, but is usually referred to collectively as the canopy resistance (Seinfeld and Pandis, 2016).

In addition to the resistance model of dry deposition flux, the bi-directional flux of ammonia may have to be considered. When the concentration of ammonia in the atmosphere is higher than the ammonia compensation point at the surface, ammonia will deposit to the vegetation-soil system whereas when the compensation point of ammonia is higher in the soil and vegetation, ammonia will be emitted to the atmosphere (Pleim et al., 2013; Farquhar et al., 1980). In the scope of this study, bi-directional flux was not considered to be important.

1.3 Previous Research

This study builds off initial research conducted on the Delmarva Peninsula in 2004 by Siefert et al. (2013). Siefert et al. used inverse modeling to determine the emission strength of the initial poultry operation, while the model used in this study infers the original strength of the emission source from Maryland AFO population data and emission factors from CMU/EPA.

O'Shaughnessy and Altmaier (2011) also used inverse modeling using the American Meteorological Society (AMS)/U.S. EPA Regulatory Model (AERMOD). The objective of this study is to simulate the concentrations and deposition at points downwind and later in time assuming the initial strength with emission factors from the U.S. EPA/CMU. Unfortunately, due to the large differences in emission strength, the results of Siefert et al. (2013) and this study are expected to be too different to be compared.

Overall, few studies have attempted to apply AERMOD to horizontal scales of >100km. The main concern is the application of implied horizontal homogeneity assumption in similarity theories and relations used in AERMOD. However, these assumptions are likely to be valid over Delmarva Peninsula due to its flat terrain. In addition, AERMOD has not been used to simulate the dispersion of atmospheric ammonia, as compared to its applications to other compounds. Sutton et al. (1998) conducted a study utilizing AERMOD's dispersion calculations in the United Kingdom (U. K.) to model ammonia in a rural landscape, locally. That study found that AERMOD shows accuracy despite no inclusion of the bi-directional flux and land-cover data which would influence the transport distances.

It is also important to keep in mind that an important assumption of this study is that no waste management practices or environmental technologies are used to mitigate ammonia emissions throughout the modeling domain, and that the facilities are producing at maximum animal capacity at all times throughout the duration of the simulation. This will provide an upper-limit scenario for ammonia/nitrogen deposition and concentration values.

1.4 Dispersion Modeling

AERMOD is EPA's preferred dispersion model for near-field applications, promulgated in 2005 and revised in 2017 (U.S. EPA, 2005, 2017). It is similar to other dispersion models in that they are designed to model the transport of certain chemicals. Initially, the U.S. Military began to experiment with dispersion modeling due to fear of chemical weapons (U.S. EPA, 2013). This led to scientists becoming aware of atmospheric dispersion. At first, gradient transport theories with constant and variable eddy diffusivities were proposed. More sophisticated statistical theories were developed by Taylor (1922). Both horizontal and vertical dispersion were later investigated using the Gaussian and non-Gaussian plume dispersion equations that are utilized in AERMOD (Arya, 1999).

AERMOD uses steady-state plume modeling to calculate concentrations and depositions with the goal of minimizing errors in model output due to small changes in input parameters (U.S. EPA, 2013). The horizontal and vertical concentration distributions are assumed to be Gaussian in the stable boundary layer (SBL) and unlike many dispersion models, it is assumed to be a bi-Gaussian probability density function following statistical concentration distributions in the convective boundary layer (CBL) (Deardorf and Willis, 1985; Briggs, 1993). The general form of concentration distribution in AERMOD within both the SBL and the CBL is:

$$C(x,y,z) = \frac{Q}{U} P_y(y,x) P_z(z,x) \quad (1)$$

where C is the average concentration, Q is emission strength, U is the average wind speed, and P_y and P_z are the probability density functions describing the concentration as a statistical expression away from the model centerline (Peters, 2015). Divisions occur between the CBL, SBL capping the CBL for pollutants emitted by near-surface sources, and the transition between the two. However, most time is spent in the CBL and final concentrations are determined by several forms of dispersion equations describing vertical dispersion, lateral dispersion, and natural centerline fade dispersion (U.S. EPA, 2013). While concentration calculations are at the forefront of the AERMOD formulation, deposition is the most important parameter discussed in this study. Chamberlain (1953) describes the simple deposition model used in AERMOD's formulation involving calculations of ground-level concentrations (GLC) due to a continuous point source:

$$C_0(x,y,0) = \frac{Q_x}{\pi\sigma_y\sigma_z U}\exp\left(-\frac{y^2}{2\sigma_y^2}\right)\exp\left(-\frac{H^2}{2\sigma_z^2}\right) \tag{2}$$

where Q_x is the depleted source strength downwind at a distance of x and governed by the mass equation:

$$\frac{\partial Q_x}{\partial x} = -\int_{-\infty}^{\infty} F_d(x,y)\,\partial y \tag{3}$$

And the dry deposition flux:

$$F_d(x,y,0) = v_d C_0(x,y,0) \tag{4}$$

This is termed as a source-depletion model and is a linear relationship allowing deposition to be calculated from GLC calculations with previous determination of SBL and CBL contributions within AERMOD calculations and a prescribed deposition velocity (v_d) (Cimorelli et al., 2005).

Several studies in the past have used AERMOD's dispersion capabilities. Many studies have modeled hydrogen sulfide (H_2S) emissions and dispersion using AERMOD. Some studies have used AERMOD to determine emission factors for better representation of emission from agricultural practices, using an inverse modeling approach. O'Shaughnessy and Altmaier (2011) found that AERMOD worked effectively when using inverse modeling, especially at distances of less than 6,000 m. Other studies have used AERMOD at local scales, but our literature search did not find any AERMOD-related studies that incorporated areas larger than 50 x 50 km^2. Attempting to apply AERMOD to larger domains makes this study unique. Other studies have successfully applied AERMOD to a local application of ammonia. Bajwa et al. (2008) used AERMOD to determine deposition velocities under different seasons and stability conditions. Deposition velocities were modeled on a local scale and found that total deposition occurred within 2,500 m of the source. Theobald et al. (2012) compared AERMOD, Atmospheric Dispersion Modelling System (ADMS), Local Atmospheric Dispersion and Deposition (LADD), and the Operational Priority Substances model (OPS-st) in terms of concentration within 1,000 m of a source. Input processes were varied throughout their study which found that for area and volume sources, AERMOD and OPS-st predicted larger concentrations for a case study. Overall AERMOD, ADMS, and OPS-st performed well within the range of acceptability criteria. Hanna et al. (2001) compared ADMS, AERMOD, and Industrial Source Complex (ISC3) at downwind distances of 10 to 20 km. A total of 6 sites were used in their comparison. AERMOD shows better performance at 3 of these 6 sites over ADMS and ISC3.

AERMOD utilizes three forms of meteorological data: (1) site-specific data, i.e. a local meteorological tower, (2) National Weather Service (NWS) or Federal Aviation Administration sites, or (3) prognostic meteorological data. The most readily available data is NWS data, which was used in this study.

AERMOD does not include a system for simulating the conversion of NH_3 to NH_4^+ or the formation of particulate matter from NH_4^+ salts. Therefore, we have only simulated atmospheric concentrations of NH_3 and dry deposition of gaseous NH_3. This neglects the formation of NH_4^+ particulate matter and the potential dry and wet deposition of NH_4^+ particulate matter, and may result in some overestimation of gaseous NH_3 concentration and NH_3 dry deposition. These effects are minor at close proximity to the emission sources, such as where monitor to model comparisons are made in this study.

1.5 Deposition Velocities

Schrader and Brummer (2014) reviewed published ammonia deposition velocities for various land use types and found annual mean values ranging from 0.1 to 1.8 cm/s for semi-natural, 0.4 to 3.0 cm/s for mixed forests, and 0.2 to 7.1 cm/s for agricultural sites. Deposition velocities span more than an order of magnitude within and across land use types. Phillips et al. (2004) conducted their study in an area similar to the Maryland Eastern Shore, which was described as a semi-natural site downwind of the North Carolina State University Research Farm in central North Carolina. Measurements were not taken at the facility but were taken downwind over turf grass. They did not take direct measurements at a CAFO, but several samplers were located downwind (~ 1km) of large facilities and in open grass fields.

In general, semi-natural sites have a relatively low deposition velocity with many ranging from about 0.6 – 1.8 cm/s (Bajwa et al., 2008; Benedict et al., 2013; Kirchner et al., 2005; Myles et al., 2011). Variation is due to the area of study and time of year. Most studies report deposition velocities during the fall season with some reporting annual means for comparison (Bajwa et al., 2008; Phillips et al., 2004; Myles et al., 2011). Phillips et al. measured a deposition velocity of 2.8 cm/s during the daytime in the fall. Stability, ground temperature, moisture, and other factors may also limit or amplify deposition velocities.

Our main area of interest in the literature review involves agricultural production. In areas downwind of agricultural soils, deposition velocities are expected to be lower than any other type of land types considered unless the measurements are taken downwind of the ammonia source or in areas of intensive agriculture (Schrader and Brummer (2014)). This is reflected in a study done by Myles et al. (2011) which reported a deposition velocity at 7.1 cm/s over a fertilized soil. Other studies such as Baek et al. (2006) found a deposition velocity of 6.3 cm/s downwind fetch of an ammonia source. Studies with deposition velocities below 1 cm/s are likely located within a few hundred to 1,000 m of an ammonia source or in soils with a high ammonia concentration (Bajwa et al., 2008). Theobald et al. (2012) used a deposition velocity of

0.15 cm/s in a study that compares local transport of ammonia within 1 km of a source using different dispersion models. Pleim et al. (2013) provide some reasoning for this with more in-depth analysis provided by Cooter et al. (2010) for agricultural soils specifically. The ammonia/nitrogen bi-directional flux can cause areas of low deposition velocities near ammonia/nitrogen sources. High concentrations tend to increase the surface resistance, which will decrease the effective dry deposition velocity and decrease the overall deposition to an area. Therefore, a constant deposition velocity may not capture the extent of ammonia transport near areas of high concentration such as downwind of intensive animal operations. This difference can be as high as a factor of 10 at the source and a factor of 2, 60 m downwind of the source (Jones et al., 2007). Furthermore, it would be an additional benefit to include variable deposition velocities based on land-use categories. Within the model formulation, the user is allowed to define land-use characteristics in relation to the source. With a large quantity of modeled sources and unknown land-use characteristics of each individual site, the same land-use is assumed for the entirety of the region. Defining land-use at each site individually will improve the quality of modeled transport and provide more detailed surface characteristics that are used in the model output calculation.

2. Methods

2.1 Measurements

Ambient ammonia concentration was measured at 23 sites on Maryland's Eastern Shore during two sampling events of two weeks each i.e. September 8 to 22, 2017 and September 22 to October 6, 2017 (Figure 3). Data were used to calibrate AERMOD. The CEH Adapted Low-Cost Passive High Absorption (ALPHA) sampler (Figure 2) (a passive sampler) was used to measure NH_3 in air. The sampler uses a phosphorus acid-coated filter, which serves to capture

results from the AERMOD simulation show that 72.4% of nitrogen is deposited due to ammonia/nitrogen release from poultry CAFOs. A comprehensive sensitivity analysis of the effect of ammonia deposition velocity on estimated annual ammonia deposition is provided (Table 1) over the 2 km by 2 km modeling domain covering the Maryland Eastern Shore and Chesapeake Bay. These additional deposition velocities include 1.0 cm/s, 2.0 cm/s, and 3.0 cm/s.

3.3 Simulation Results for a Single Facility

Annual averages were calculated for a single facility in central Maryland Eastern Shore using a modeled deposition velocity of 2.4 cm/s. For this single facility, multiple attributes were investigated to better understand deposition and concentration. The main area of investigation is deposition as a function of distance from the poultry facility. Results show that for the average meteorological conditions on the Maryland Eastern Shore, and a deposition velocity of 2.4 cm/s, homes and businesses within 2,500 m of the facility will experience average ammonia concentrations of 2.8 μg m^{-3} (4.0 ppb). Under certain conditions, the short-term concentration can be much higher and above the threshold for human detection (which is approximately 5,000 ppb) of ammonia/nitrogen. While this has no known health effects, it is a significant nuisance for communities near poultry CAFOs (National Research Council, 2003). Concentrations quickly decline from this value to below 1.0 ppb beyond 2,500 m in either direction away from the source facility.

Approximately 40% of total emissions were found to be deposited within 2,500 m of an AFO source. Figure 10 shows the cumulative ammonia deposition (% of emission) as a function of distance (m) from the source (for a deposition velocity of 2.4 cm/s) for a single poultry facility. Bajwa et al. (2008) found, on average, that approximately 9% of the total emissions from the source was deposited within 2,500 m of the source. Figure 11 provides average annual ammonia deposition flux (g $m^{-2}yr^{-1}$) as a function of distance (m) from the source (for a deposition velocity of 2.4 cm/s) for a single poultry facility. Deposition fluxes decrease exponentially from the source as described by the Gaussian plume equation relating concentration and deposition described above in equations (2) and (4). This is an expected result and a function of the model formulation. It is important to note that the model does not incorporate the ammonia bi-directional flux. The highest amount of deposition occurred immediately adjacent to the source where concentrations were at their highest. This is corroborated by Theobald et al. (2012) which found that concentrations will decrease to 1 μg m^{-3} or less at 1,000 m from a ground-level area source.

In the single facility simulation, total deposition within 50 km was found to be about 70% of the total emissions.

3.4 Simulation Results for the Larger Domain

Concentration results (Figure 12 A, B) for a deposition velocity of 0.15 cm/s and 2.4 cm/s show an average ammonia concentration of 1.40 μg m^{-3} and 0.48 μg m^{-3} respectively across the entire modeling domain. As Figure 12 (A, B) shows, the highest concentrations occur over the Eastern Shore with a minimum in concentration over the Chesapeake Bay. The amount of ammonia/nitrogen reaching the Bay waters is likely higher owing to the deposition to the landmass or other inland water bodies and subsequent transport into the Chesapeake Bay. Unfortunately, determining the deposition to rivers, streams, and tributaries would be very difficult without land-use satellite data. Furthermore, understanding how this ammonia/nitrogen is transported to the Bay waters itself is a separate issue as it is not advised to assume that all the nitrogen from ammonia/nitrogen deposited on land is ultimately transported to the Chesapeake Bay (Nus and Kenna, 2012). Additionally, meteorological factors such as land-sea breeze would limit transport to the Bay in general. Winds will blow perpendicular to the shore during the day where temperature gradients between the land and the water occur (a common condition met in the area, but not measured in meteorology used in AERMOD simulations). This would protect Bay waters during appropriate atmospheric conditions. Winds from the southwest will enhance this push away from the Bay waters as strong southwesterly winds advect ammonia concentrations toward southwestern Delaware (Figure 9).

AERMOD reports average deposition fluxes for each receptor within the modeling domain. The use of a constant Vd implies a linear relationship between flux and concentration. Because of the linear relationship between deposition flux and concentration, the spatial patterns of deposition are similar to the spatial pattern of concentration. Using a deposition velocity of 0.15 cm/s and 2.4 cm/s (Figure 12 C, D) provides annual average deposition flux (including both dry and wet deposition) over the course of a single year from poultry AFOs on the Maryland Eastern Shore. Deposition fluxes are calculated hourly and averaged over the entirety of the modeling period and reported as an average deposition flux. Average deposition fluxes show that throughout the year with meteorological observations and a deposition velocity of 0.15 cm/s, deposition over the modeling domain is calculated to be approximately 2,044 Mg (2,252 U.S. Tons); and for a deposition velocity of 2.4 cm/s, deposition over the modeling domain is calculated to be approximately 11,086 Mg (12,220 U.S. Tons). Overall emissions totaled to 15,345 Mg (16,914 U.S. Tons). Figure 13 shows the impact of increasing deposition flux on the domain-wide deposition as a fraction of emissions. Using a deposition velocity of 2.4 cm/s, the fractional deposition was calculated as ~72% within the modeling domain. Moreover, modeling suggests that for a deposition velocity of 2.4 cm/sec for a single poultry facility, 30% of emissions will be deposited ~500m distance and ~38% of emissions will be deposited ~2,000 m from the source (Figure 10). Walker et al. (2008) found that about 10% of the emitted ammonia from a swine production facility deposited to the surface within about 500 m of the source. Fowler et al. (1998) found that about 3-10% of the locally emitted ammonia will deposit back locally. Asman (1998) incorporates much of the improvement in understanding of NH_3, emission, transport and deposition over the last two decades and shows that up to 60% of the NH_3, emitted from sources up to 3 m in height, may be deposited within ~2000 m of the source. Using a regional chemical transport model, Dennis et al. (2010) found that a fractional deposition of around 8-15% of total emissions will occur within 12 km of a source facility.

Linker et al. (2013) estimated roughly 2,830 Mg of ammonia/nitrogen was directly deposited to the Chesapeake Bay's tidal surface waters. By comparison, we estimated total ammonia deposition per year to the Chesapeake Bay is approximately ~508 Mg (418 Mg of nitrogen) using a deposition velocity of 2.4 cm/s. Worth noting is that our source inventory was limited to Maryland poultry AFOs and the mainstem of the Chesapeake Bay, whereas Linker et al. (2013) included all animal sources within the watershed and all tidal waters.

A comprehensive sensitivity analysis of ammonia deposition velocity on estimated annual ammonia deposition is provided (Table 1) over the regional modeling domain covering the Maryland Eastern Shore and Chesapeake Bay. This indicates that ~5% of the total deposition that occurs within the domain is depositing to the Chesapeake Bay waters directly. Moreover, this does not include the additional input from indirect deposition to rivers, streams, and groundwater which will likely transport to the Chesapeake Bay. It is important to note that all poultry houses are assumed to be at capacity year-round with constant emissions. Emission factors also introduce error into the model as they can vary based on waste management practice, weather, and poultry growth state. Finally, we did not assume any facilities were using waste amendments, such as aluminum sulfate, to control ammonia emissions.

Meteorological effects will have a significant impact on the deposition (both wet and dry) over the domain. The most critical of these meteorological parameters affecting atmospheric dispersion and deposition are wind speed, wind direction, and stability (Arya, 1999). Figure 9 A shows the wind rose of the meteorology (wind speed and direction) used in the main simulation. A predominant wind from the southwest is seen approximately 5% of the time. This will transport ammonia away from the Chesapeake Bay, and cause higher concentrations to exist over the terrestrial surface northeast of the concentration of sources. This is similar to wind rose during the measurement period (Figure 9 B). The second most common wind direction is from the north/northwest. More stable conditions at night will tend to increase concentrations at the surface and lead to more deposition at this time of day (Arya, 1999). Unstable conditions will allow the plume to disperse more effectively and lead to low concentrations (Arya, 1999).

4.0 Conclusions

This analysis is a combination of measurement and modeling of ammonia concentration/deposition to the Maryland Eastern Shore land and the Chesapeake Bay from poultry operations over the Delmarva Peninsula. The application of AERMOD to estimate fate and transport of ammonia from poultry operations has promise. The model was able to reliably predict ammonia concentrations from sites (samplers 8 and 9) that were closest to the source has proven to be accurate in predicting concentrations when validating with meteorology and sampling results close to the source (Figures 3, 7 and 8). However, AERMOD’s concentration predicting capability decreases when applied to a regional scale. AERMOD’s ability to predict concentration drastically improved when considering sampled concentrations near the source cluster. Figure 6 shows the mean bias applied to only samplers 8 and 9 and reports mean bias near 0 for a deposition velocity of 2.4 cm/sec. This is an encouraging result when applying the model to localized areas. Significantly higher mean biases in samplers at large distances from the source region are likely due to localized sources and the location of samplers being upwind of the largest cluster of poultry AFOs (Figure 7).

Direct annual deposition to the Chesapeake Bay is estimated to range from ~163 Mg (180 U.S. Tons) for a deposition velocity of 0.15 cm/s to ~508 Mg (560 U.S. Tons) for a deposition velocity of 2.4 cm/s. These values, especially the estimate using the 2.4 cm/s deposition velocity, are within the range of Linker et al. (2013) who estimated roughly 2,830 Mg of nitrogen in the form of ammonia was directly deposited to the Chesapeake Bay's tidal surface waters. However, it is known that AERMOD is unable to calculate mesoscale meteorological features without being provided with appropriate weather data. Location of weather data used for this study was limited to an area in the center of the peninsula. In areas near the coast, sea breezes and other weather features of the marine environment will likely affect deposition calculations to the Bay. During the daytime, winds blowing inland will likely limit deposition to the Bay, but some conditions such as marine instabilities during the fall and early winter could exist to significantly increase deposition to the Bay surface. From this study, it is clear that direct deposition of ammonia/nitrogen to the Chesapeake Bay is less than the deposition to land, rivers and tributaries within the watershed.

A single facility analysis was performed using a deposition velocity of 2.4 cm/s; which was determined from a sensitivity analysis of measured concentrations in an attempt to determine transport distances of ammonia from broiler CAFOs (Figure 10). We estimate that approximately 40% of the ammonia/nitrogen deposition occurs within 2,500 m of the source.

Overall, the emissions from poultry totaled to 15,345 Mg/yr. When using a deposition velocity of 2.4 cm/s, deposition over the modeling domain is calculated to be approximately 11,086 Mg/yr. This result is consistent with previous studies (Linker et al, 2013). However, it is interesting to compare and contrast these results for a lower deposition velocity e.g. deposition velocity of 0.15 cm/s. The deposition to the modeling domain is estimated to be around 2,044 Mg/yr. Indirect deposition due only to broiler CAFOs to the Chesapeake Bay remains unknown. Of the emitted ammonia, 13% is deposited back to the domain (using a deposition velocity of 0.15 cm/s); while ~72% is deposited back to the domain (using a deposition velocity of 2.4 cm/s). With nearly ~90% of the modeled deposition settling to the landmass, indirect deposition will clearly provide the largest proportion of deposition to the Chesapeake Bay from river transport. Unfortunately, AERMOD does not allow users to get a specific land-use data set to be used in the analysis phase of the output. Additionally, vegetation is an important consideration of this study. Dense forests will likely limit direct deposition to the Bay by taking up ammonia that would otherwise deposit to the water surface. These dense forests are near rivers and water bodies and may further limit deposition to the Chesapeake Bay. Moreover, use of Best Management Practice (BMP) of using aluminum sulfate in the poultry houses for reducing ammonia emissions was not accounted for.

Poultry CAFOs were assumed to be at capacity during the duration of the model simulation. This is not a realistic approach, since it is difficult to model the temporal emissions from a single facility for 603 separate facilities. Modeling scenarios, however, could be improved in several ways. For future research, it is suggested that the simulation is run for a single growing cycle rather than an entire annual rotation. Additionally, seasonal variation, particularly in deposition velocities, is an important variable to include. Second, we assumed all

AFOs were at capacity during the model simulation. More realistic estimates would be achieved if simulations reflected the growing cycle of the birds. Third, an estimate of the number of facilities that use waste amendments to control ammonia would improve model accuracy. Lastly, additional monitoring data would allow for better model calibration. This should address seasonal changes in emissions as well as deposition velocities. Regardless of whether realistic estimates of deposition to the Chesapeake Bay can be produced exactly in a model environment, an increase in emission will lead to an increase in deposition. Therefore, it is increasingly important to understand the effects of ammonia/nitrogen-nitrogen deposition to the Chesapeake Bay area both as the DELMARVA Peninsula experiences growth and the construction of new sources of ammonia continues.

ACKNOWLEDGMENTS

This research was supported by the Chesapeake Bay Foundation (CBF). We would like to thank CBF for providing the necessary resources to conduct the study. We sincerely thank Dr. John T. Walker, U.S. EPA, for his continued and ongoing assistance and advice during the course of this study. We thank the Soil Sciences Laboratory, North Carolina State University for providing the passive ammonia samplers; their preparation and analysis (including QA/QC) during the duration of the project's sampling campaign. We sincerely thank Mr. Alberth Nahas, Ms. Uttamang, and members of the Air Quality Research Group, North Carolina State University. The United States Department of Agriculture, North Carolina State University's High

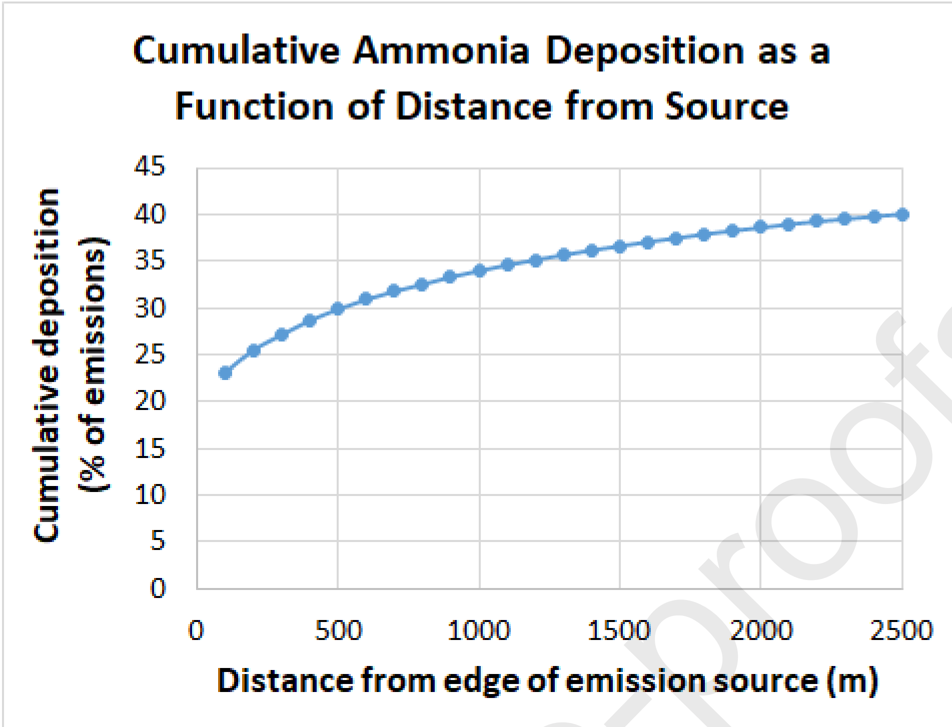


Figure 10. Cumulative ammonia deposition (% of emission) as a function of distance (m) from a source (for a deposition velocity of 2.4 cm/s), for a single poultry facility.

Table 1. Total Estimated Deposition of ammonia to the modeling domain based on AERMOD simulations for a range of deposition velocities 0.15 cm/s to 3.00 cm/s. Column A indicates the simulated deposition velocity for a single AERMOD simulation. Column B indicates the estimated annual deposition in (Mg/yr) that includes deposition during calm conditions (this required an extrapolation of average deposition flux during hours with wind speeds equal to 0 cm/s). Column C indicates the estimated annual deposition as a fraction of emissions. Column D indicates the estimated annual deposition that occurred over the Bay waters (this can be viewed as direct deposition to the Bay water surface). It is assumed that any location within the modeled domain that has an elevation ≤0 meters is the water surface of the Chesapeake Bay. Column E indicates the estimated annual deposition to the landmass (i.e. deposition to the modeling domain landmass other than the Bay). Column F gives the percent of estimated annual deposition that deposits directly to the Chesapeake Bay water surface based on column D and column B. Column F estimate does not include rivers, marshland, minor tributaries, or other water bodies, or ground water flow to the Bay.

A. Deposition Velocity (cm/s)	**B.** Estimated Annual Deposition (within the modeling Domain) (Mg/yr)	**C.** Deposition as a Fraction of Emissions (within the modeling Domain) (%)	**D.** Estimated Annual Deposition to the Chesapeake Bay (Mg/yr)	**E.** Estimated Annual Deposition to the Remainder (other than the Bay) of the Modeling Domain (Mg/yr)	**F.** Percentage of Estimated Annual Deposition that Deposits to the Chesapeake Bay (%)
0.15	2,040	13.4	163	1,880	7.97
1.00	7,400	48.4	401	7,000	5.42
2.00	10,260	67.0	486	9,770	4.73
2.40	11,100	72.4	508	10,600	4.58
3.00	12,100	79.2	531	11,600	4.37

(1 Mg = 10^6 g = 1.1023 U.S. Tons)

APPENDIX 4, EXHIBIT D

Chesapeake Bay Model Estimate of Nitrogen Pollution from Animal Feeding Operations
(R. at 0478.)

This exhibit shows the number of pounds of nitrogen pollution from Animal Feeding Operations in Maryland, by county, estimated by the Chesapeake Bay Model, as discussed in the Administrative Record on page 0478 and referenced in the memorandum of law on page 2 and 34.

To access this information, see:
https://cast.chesapeakebay.net/.

Data Source Version	CAST-2019
File Creation Date	10/20/2020
Summary Loads Report	This report provides scenario-specific data on loads. The loads are provided for the aggregations, geography, and scenarios that you selected. Definitions for aggregations and geographies are available at https://cast.chesapeakebay.net/Reports/RetrievePublicReport?reportType=1. The edge of stream (EOS) and edge of tide (EOT) loads are provided for total nitrogen (N), total phosphorus (P), and total suspended solids (S). The loads are pounds per year. The unit column is the measurement only for the amount column.

Geography	**Sector**	**LoadSource**	**Allocation**	**Agency**	**2019 Progress_NLoadEOS**	**2019 Progress_NLoadEOT**
Allegany, MD (CBWS Portion Only)	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	-	-
Anne Arundel, MD (CBWS Portion Only)	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	-	-
Baltimore City, MD (CBWS Portion Only)	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	-	-
Baltimore, MD (CBWS Portion Only)	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	4,551	1,959
Calvert, MD (CBWS Portion Only)	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	-	-
Caroline, MD (CBWS Portion Only)	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	69,984	52,635
Carroll, MD (CBWS Portion Only)	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	8,909	4,802
Cecil, MD (CBWS Portion Only)	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	16,696	14,642
Charles, MD (CBWS Portion Only)	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	-	-
Dorchester, MD (CBWS Portion Only)	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	11,835	7,424
Frederick, MD (CBWS Portion Only)	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	51,925	37,742
Garrett, MD (CBWS Portion Only)	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	-	-
Harford, MD (CBWS Portion Only)	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	-	-
Howard, MD (CBWS Portion Only)	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	-	-
Kent, MD (CBWS Portion Only)	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	28,042	23,534
Montgomery, MD (CBWS Portion Only)	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	-	-
Prince Georges, MD (CBWS Portion Only	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	-	-
Queen Annes, MD (CBWS Portion Only)	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	7,261	5,573
Somerset, MD (CBWS Portion Only)	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	22,653	18,002
St. Marys, MD (CBWS Portion Only)	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	-	-
Talbot, MD (CBWS Portion Only)	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	1,566	1,440
Washington, MD (CBWS Portion Only)	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	4,033	3,616
Wicomico, MD (CBWS Portion Only)	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	-	-
Worcester, MD (CBWS Portion Only)	Agriculture	Permitted Feeding Space	Waste Load Allocation	Non-Federal Agencies	-	-
Total					**227,454**	**171,370**

APPENDIX 4, EXHIBIT E

Wheeler, Eileen F., et al. "Ammonia emissions from twelve US broiler chicken houses." Transactions of the ASABE 49.5 (2006) 1495-1512.

(R. at 0484. n.38)

This exhibit includes a single table from a leading study exploring ammonia emissions from U.S. broiler operations. Emissions factors from broiler operations has been studied exhaustively over the past 20 years, as discussed in the Administrative Record on pages 0484 to 0485 and referenced in the memorandum of law on page 3.

To access the full publication, see: https://pdfs.semanticscholar.org/f17a/d0a9a7eac8fca63ad5e8533554117aab2315.pdf

Daily Ammonia Emission Rate Estimate

An estimate of daily NH_3 emissions per bird (± std. error) from all data from all four farms, as shown in figure 9c, is thus:

$$ER_b = 0.031\ (\pm 0.0011) \cdot age \qquad (4)$$

where

ER_b = emissions rate (g NH_3 $bird^{-1}$ d^{-1})

age = flock age (d) if built-up litter is used:

age = 0 d if new litter and flock age is <7 d;

age = (flock age − 6) d if new litter and flock age is ≥7 d.

Table 4 provides comparison of ammonia emission rates measured during field trials in commercial broiler houses in the U.S. and Europe during the past 15 years. All study data are expressed in terms of ammonia emission per bird per day, which usually required conversion of the originally reported results based on information provided (or inferred) from the research article. One of the challenges in understanding and reporting emission data is the wide variation in reporting units that are not always inter-convertible depending on the supporting information provided in the article. Annual data was problematic for conversion of broiler emission data since buildings are unoccupied during cleanout between flocks, with reduced (typical) emissions due to cooler interior temperatures, no additional manure deposition, opportunity to reduce litter moisture content with no further moisture addition, and eventually spent litter removal (for houses using new litter each flock), which eliminates the ammonia source. The report for annual emission factors should indicate the number of days in a year, since it may range from about 250 to 290 days when based on bird occupancy, instead of 365. In conversions of data (table 4) that were originally expressed in terms of 500 kg animal unit (livestock unit), average bird weight during a flock grow-out was estimated as one-half the finished market weight. Although this may underestimate average broiler weight due to rapidly increasing growth rate after about two weeks of age, it is the simplest available means when detailed growth curves are not provided with the data. The techniques and challenges of estimating annual emissions from broiler facilities are included in Gates et al. (2005b).

Table 4. Summary of ammonia emission rates from broiler houses as determined via actual measurements (rather than mass balance) expressed in terms of flock average emission while birds occupied the house. Where necessary, data were converted from original units to common expression using average bird mass.

Reference and Study Location	Flock Characteristics: Market Age[a] (days)	Final Weight (kg)	Stocking Density (b m^{-2})	Litter[b]	Emission Rate (g NH_3 b^{-1} d^{-1})	Monitoring: Number of: Houses (Flocks)	Seasons[c]	Periods	Duration	Method[d]
Wheeler (this study), U.S. (Pennsylvania and Kentucky)	42 (1-45)	2.2	14.7	N	0.47	2 (5 each)	All	13	48 h	C-EC
	42 (2-42)	2.2	14.7	B, T	0.65	2 (6 each)	All	13	48 h	C-EC
	49 (1-53)	2.5	13.4	B, T	0.76	4 (6 each)	All	17	48 h	C-EC
	63 (1-55)	3.3	10.8	B, T	0.98	4 (5 each)	All	20	48 h	C-EC
Seifert et al (2004), U.S. (Delaware)	42 (29-37)	n/a	20.0	B?	1.18	1 (1)	Sp, Su	7	6-12 h	S-CM[e]
Müller et al (2003), Germany and Czech Rep.	32 (13-30)	1.6	n/a	N?	0.09	2 (1)	W	5	1 h	C-PS?
Lacey et al (2003), U.S. (Texas)	49 (8-47)	2.4	13.5	B	0.63	4 (3 each)	Su, F	10	3 S/d	S-CM
Burns et al (2003), U.S. (Tennessee)	42 (1-42)	2.3	16.1	B	0.92	1 (9)	All	9	42 d	C-EC
Demmers et al. (1999), United Kingdom	32 (1-32)	1.9	25	N	0.11	1 (1)	Su	1	32 d	C-CL
Wathes et al (1997), United Kingdom	32 (24-35)	1.1W 1.4 Su	9.3 W 9.4 Su	N?	0.26	4	Su, W	2	24 h	C-CL
Groot Koerkamp et al (1998)										
United Kingdom	--[f]	--	--	N?	0.48	4	Su, W	2	24 h	C-CL
The Netherlands	--	--	--	N?	0.27	4	Su, W	2	24 h	C-CL
Denmark	--	--	--	N?	0.21	4	Su, W	2	24 h	C-CL
Germany	--	--	--	N?	0.44	4	Su, W	2	24 h	C-CL

[a] Age during measurement shown in parentheses.
[b] Litter: N = new, B = built-up, and T = treated.
[c] Season: Sp = spring, Su = summer, F = fall; W = winter, and All = all seasons.
[d] Monitoring method: C = continuous, S = sample, discrete, EC = electrochemical extraction, PS = photoacoustic extraction, CL = chemiluminescence extraction, and CM = colormetric tube.
[e] Downwind passive samplers and Gaussian plume model back-calculation of emission at building.
[f] Flock characteristics not provided, so data not converted to average bird weight basis.
? = Not explicitly stated but inferred from data, statements in article, or common practice.
n/a = Not available.

APPENDIX 4, EXHIBIT F

United States Geological Survey Short Term and Long Term Pollution Monitoring Trends of Major Chesapeake Bay Tidal Tributaries

(R. at 0474.)

This exhibit shows the short-term and long-term nitrogen and phosphorus pollution trends from the nine "River Input Monitoring" stations operated by the U.S. Geological Survey for the Chesapeake Bay Program, including increasing pollution for the Choptank River over the short term and long term for both forms of nutrient pollution, as discussed in the Administrative Record on page 0474 and referenced in the memorandum of law on page 5.

To access this information, see: https://www.sciencebase.gov/catalog/item/5ed6bcd882ce7e579c6499ea

Table 1. Summary of long-term (1985-2019) and short-term (2010-2019) trends in nitrogen, phosphorus, and suspended-sediment loads for the River Input Monitoring stations.

[Improving or degrading trends classified as likelihood estimates greater than or equal to 66 percent]

Monitoring station	Total nitrogen load		Total phosphorus load		Suspended-sediment load	
	Long term	Short term	Long term	Short term	Long term	Short term
SUSQUEHANNA RIVER AT CONOWINGO, MD	Improving	No Trend	No Trend	Improving	Degrading	Improving
POTOMAC RIVER AT WASHINGTON, DC	Improving	Improving	Improving	Improving	Improving	No Trend
JAMES RIVER AT CARTERSVILLE, VA	Improving	Improving	Improving	Improving	No Trend	Improving
RAPPAHANNOCK RIVER NR FREDERICKSBURG, VA	Improving	No Trend	Degrading	No Trend	Degrading	No Trend
APPOMATTOX RIVER AT MATOACA, VA	Degrading	Degrading	Degrading	Degrading	No Trend	Degrading
PAMUNKEY RIVER NEAR HANOVER, VA	Degrading	No Trend	Degrading	Improving	Degrading	Improving
MATTAPONI RIVER NEAR BEULAHVILLE, VA	No Trend	Degrading	No Trend	No Trend	No Trend	Degrading
PATUXENT RIVER NEAR BOWIE, MD	Improving	Improving	Improving	Improving	Improving	Improving
CHOPTANK RIVER NEAR GREENSBORO, MD	Degrading	Degrading	Degrading	Degrading	Improving	Degrading

References Cited

Chanat, J.G., Moyer, D.L., Blomquist, J.D., Hyer, K.E., and Langland, M.J., 2015, Application of a weighted regression model for reporting nutrient and sediment concentrations, fluxes, and trends in concentration and flux for the Chesapeake Bay Nontidal Water-Quality Monitoring Network, results through water year 2012: U.S. Geological Survey Scientific Investigations Report 2015–5133, 76 p., accessed January 14, 2015, at https://pubs.er.usgs.gov/publication/sir20155133/.

Moyer, D.L. and Blomquist, J.D., 2020, Nitrogen, phosphorus, and suspended-sediment loads and trends measured at the Chesapeake Bay River Input Monitoring stations—Water years 1985–2019: U.S. Geological Survey data release, https://doi.org/10.5066/P9VG459V.

Additional Information and USGS Contacts

For more information on this topic, visit the “Water-Quality Loads and Trends at Nontidal Monitoring Stations in the Chesapeake Bay Watershed” website at https://cbrim.er.usgs.gov/., or contact:

Doug Moyer **dlmoyer@usgs.gov**
Joel Blomquist **jdblomqu@usgs.gov**

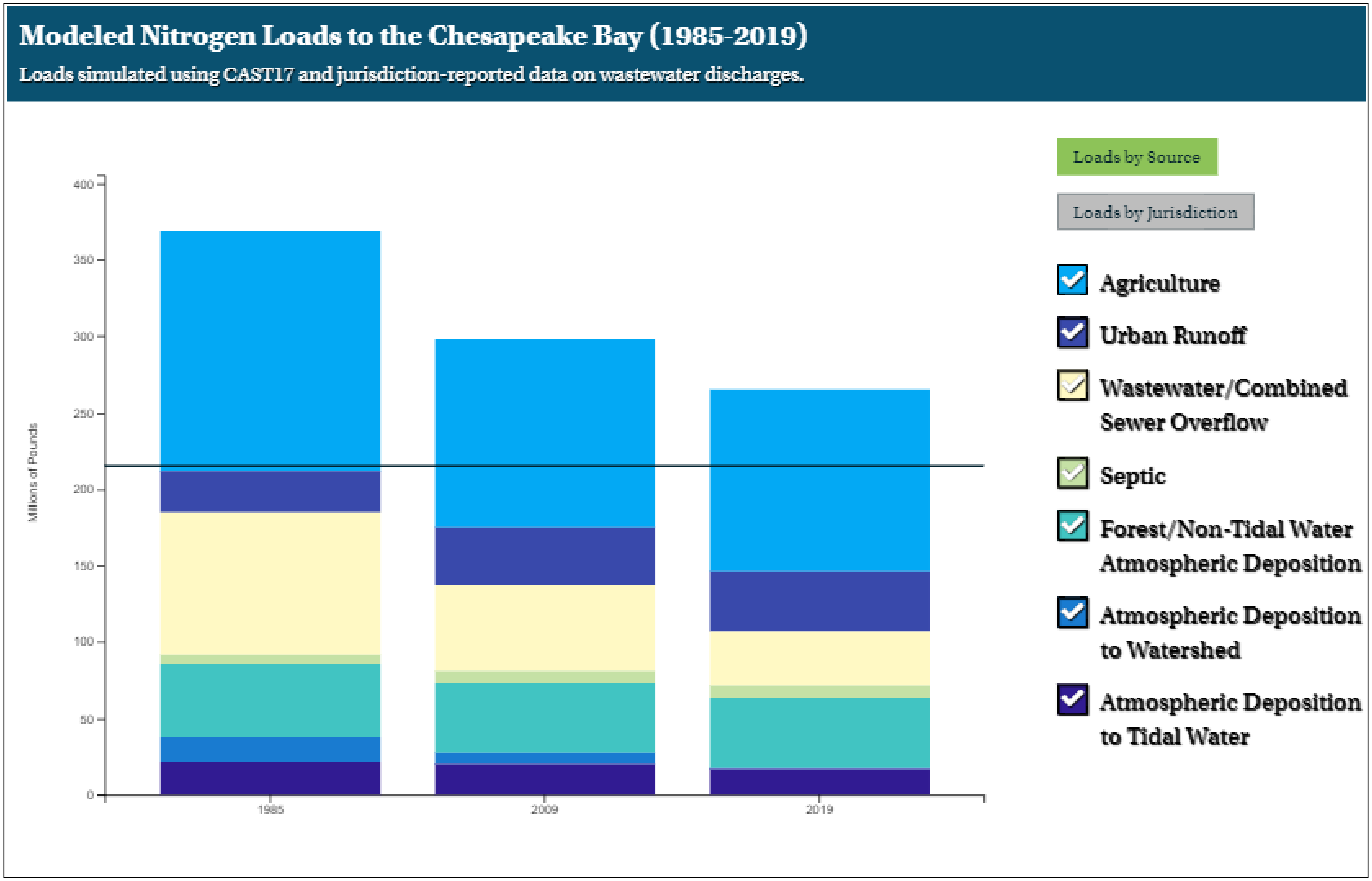
For more information on USGS Chesapeake Bay studies, visit http://chesapeake.usgs.gov/, or contact Scott Phillips, **swphilli@usgs.gov.**

APPENDIX 4, EXHIBIT G

<u>Chesapeake Progress: Modeled Nitrogen Loads to the Chesapeake Bay (2009-2017)</u>
(R. at 0473 n.3)

This exhibit shows the Bay Model loads by sector discussed in the Administrative Record on page 0473 and cited in footnote 3 and referenced in the memorandum of law on page 5.

For more information, see:
https://www.chesapeakeprogress.com/clean-water/2017-watershed-implementation-plans



Modeled Nitrogen Loads to the Chesapeake Bay (1985-2019)
Loads simulated using CAST17 and jurisdiction-reported data on wastewater discharges.
Loads by Source
Loads by Jurisdiction
Agriculture
Urban Runoff
Wastewater/Combined Sewer Overflow
Septic
Forest/Non-Tidal Water Atmospheric Deposition
Atmospheric Deposition to Watershed
Atmospheric Deposition to Tidal Water
Millions of Pounds
400
350
300
250
200
150
100
50
0
1985
2009
2019

.

APPENDIX 4, EXHIBIT H

Abel Russ and Eric Schaeffer, Ammonia Emissions from Broiler Operations Higher than Previously Thought, Environmental Integrity Project (Jan. 2018).

(R. at 0484-0485.)

This exhibit is a brief report exploring ammonia emissions from broiler operations. Monitoring data from U.S. broiler operations show that broiler operations emit twice as much ammonia as EPA has traditionally assumed. A typical broiler operation on the Delmarva Peninsula emits roughly 20 tons of ammonia each year, as discussed in the Administrative Record on pages 0484 to 0485 and referenced in the memorandum of law on page 8, 9 and 23.

To access this information, see:
https://www.environmentalintegrity.org/wp-content/uploads/2017/12/Ammonia-Emissions.pdf

Ammonia Emissions from Broiler Operations Higher than Previously Thought

Executive Summary

The Chesapeake Bay has long suffered from algae blooms, dead zones, and other effects on aquatic life that are caused by excess nitrogen and phosphorus pollution. The Total Maximum Daily Load (TMDL), often described as a "pollution diet" for the Bay, has resulted in significant pollution reductions, but further reductions will be necessary to restore the health of the Bay.

Ammonia, the pungent gas released from animal waste, is responsible for a significant fraction of the nitrogen load to the Chesapeake Bay each year. Airborne nitrogen is responsible for roughly one third of the nitrogen load. Historically, most of that nitrogen has been in the form of nitrogen oxides (NOx) from fossil fuel combustion and other sources. Clean Air Act regulations have produced steady declines in NOx, but ammonia has been increasing, and ammonia will soon be the dominant form of atmospheric nitrogen loads.

The largest source of ammonia emissions is livestock waste, and a large component of that source category comes from the factory farms that produce broiler chickens. Since ammonia from broilers is a significant pollution problem, we attempted to determine whether the Environmental Protection Agency was accurately estimating these emissions in its TMDL model. This report reaches the following conclusions:

A broiler chicken operation located on Maryland's Eastern Shore.

1. Broiler barns emit much more ammonia than EPA has traditionally assumed. The Chesapeake Bay model assumes that local broiler confinements emit the same amount of ammonia, per broiler, as similar facilities in Europe. Yet we know that American broiler emissions are much higher than European broiler emissions. This is due to a number of factors: We raise larger birds, and larger birds emit more

ammonia; we re-use the bedding (litter) in broiler confinements much more than European operations; and we raise our broilers in a warmer climate.

2. EPA has traditionally assumed that broilers emit 0.27 grams of ammonia per bird, per day. Based on our survey of the literature on American broiler operations, we believe that a more realistic estimate is 0.54 grams of ammonia per bird, per day.

3. Using alternative emissions factors, ammonia emissions are equal to 34.3 grams of ammonia per broiler sold, or 14.2 grams of ammonia for every kilogram of broiler sold.

4. Applying these factors to broiler statistics for the Bay states, we determined that actual ammonia emissions are roughly twice as high as what EPA assumes: EPA's emissions factor predicts emissions of roughly 20,000 tons per year, while our factors predict emissions of roughly 40,000 tons per year.

5. A typical broiler CAFO on the Delmarva Peninsula – producing 500,000 broilers each year at an average weight of six pounds – is likely emitting between 19 and 24 tons of ammonia each year. Yet EPA's emissions factor would only predict 12 tons.

In order to ensure that the EPA is accurately accounting for this important source of pollution, we urge EPA to clarify its assumptions about broiler confinement emissions, and if necessary adjust its assumptions to reflect the current state of the science with regard to American broiler operations.

Introduction

Ammonia emissions from factory farms present a clear threat to environmental quality. The prime example of this threat may be the Chesapeake Bay, where ammonia is a major contributor to persistent algae blooms and dead zones. According the U.S. EPA's Total Maximum Daily Load (TMDL) for the Chesapeake Bay, "[a]ir sources contribute about a third of the total nitrogen loads delivered to the [] Bay."[1] Specifically, using the models they had at the time, EPA estimated that atmospheric deposition was responsible for 31-36% of the total nitrogen load. Of that, the majority (78-81%) was deposited on land or non-tidal waterways and then transported to the Bay.[2]

Nitrogen deposits in various forms, mainly nitrogen oxides (NOx) and ammonia. Table 1 shows TMDL estimates of nitrogen deposition over time. Two things stand out. First, while NOx has historically been the dominant source of nitrogen deposition, ammonia is expected to be the dominant source now or in the near future. Second, while NOx deposition is falling over time, and wet ammonia deposition (ammonia that falls with precipitation) is roughly constant, dry ammonia deposition (ammonia that deposits in gaseous form) is increasing.

Table 1. Atmospheric deposition loads of nitrogen (millions of pounds as N) to the Chesapeake Bay watershed. Adapted from TMDL Table L-3.[3]

Year	Dry NOx	Wet NOx	Dry ammonia	Wet ammonia	Total N	Ammonia/total
1985	293	154	66	79	592	24%
2002	208	102	66	76	452	31%
2010	135	67	85	73	360	44%
2020	97	50	98	76	321	54%

The TMDL estimates in Table 1 suggest that ammonia deposition is currently responsible for roughly half of the atmospheric contribution, or roughly 17%, of the total nitrogen loads to the Bay.[4]

Why are ammonia emissions and deposition increasing?

Ammonia deposition is increasing for two reasons. First, changes in atmospheric chemistry, including a decline in atmospheric NOx concentrations, increase the likelihood that ambient ammonia will deposit in gaseous form. Second, ammonia emissions are increasing, due mainly to an increase in animal production and a parallel increase in manure production.[5]

Ammonia is a highly reactive gas that tends to form fine particles by combing with NOx and other gases in the air.[6] As NOx emissions fall, less ammonia is "captured" in fine particle formation. This is significant because gaseous ammonia has a short residence time in the atmosphere and deposits close to the source of emissions, while fine particles stay aloft for much longer and can travel far from the source.[7] The steep decline in NOx levels is a major victory for public health, helping to reduce smog and acid rain as well as the deadly fine particles linked to heart disease and premature death. NOx is also contributing less to nitrogen loadings in the Bay as emissions decline. But those water quality benefits will be largely offset by increases in the local deposition of ammonia no longer reacting with NOx to make fine particles.

The other factor causing an increase in ammonia deposition is the increase in ammonia emissions. Most of the ammonia in the air comes from agriculture. According to the most recent National Emissions Inventory, out of a national total of 3.9 million tons of ammonia that are emitted each year, 1 million tons come from synthetic fertilizer and 2.2 million tons come from livestock waste.[8] When animal production increases, ammonia emissions also increase. The Bay TMDL doesn't include any limits on ammonia emissions from agriculture, although EPA estimated emissions could be cut about 30% at fairly low cost.[9] Instead, EPA is counting on the NOx reductions driven by Clean Air Act rules to keep the airborne nitrogen load low enough to meet cleanup goals by 2025. That scenario will be undermined if ammonia emissions prove to be higher than EPA expects.

Within the livestock sector, one of the largest sources of ammonia is the production of chickens for meat ("broilers"). On a per-weight basis, broilers excrete more nitrogen than any other major animal production group – more than twice as much as pigs, and more than three times as much as most cows.[10]

Since 2002, broiler production in the Chesapeake Bay watershed (in pounds) has increased by 25%, driven in part by a 17% increase in the average size of the broilers being sold (see Appendix A). As we show in more detail below, this has led to a large increase in ammonia emissions over the same time period.

Estimating Ammonia Emissions from Broiler Operations

Background

The amount of ammonia released from broiler confinements can be estimated in different ways. The most direct way is to simply measure the ammonia. This has been done in several studies, described below. For most broiler production facilities, however, routine monitoring is too expensive and technically challenging. It is therefore necessary to derive more generic emissions estimating methods that can be applied to facilities without monitors.

Methods for estimating emissions come with important trade-offs. The most accurate methods are complicated and data-intensive. Other methods are easier to use, but may be less accurate. The more complicated methods have to account for the long list of variables influencing emissions. To begin with, ammonia emissions from broiler CAFOs change over time. A typical broiler operation will raise multiple flocks of broilers each year. Older, heavier birds emit more ammonia than younger, smaller birds. This means that the emissions from a broiler house will increase as a flock of birds inside the house ages. After a flock is sold, the broiler house is cleaned out, either superficially ("decaking") or with a full removal of built-up manure and bedding. The cleanouts produce pulses of ammonia emissions that depend on, among other things, the number of flocks since the last full cleanout. Other factors affecting ammonia emissions include temperature and humidity.

These variables can be accounted for in emissions models, which can be either process-based or statistical. Process-based models attempt to estimate ammonia emissions using basic physical and chemical principles and the input data described above. For example, researchers at Carnegie Mellon University have developed a model that predicts emissions based on the density of livestock in a barn, the nitrogen content of the waste, and ambient temperature.[11] Statistical models start with emissions monitoring data and attempt to predict emissions on the basis of a similar list of factors. The EPA draft Emissions Estimating Methodology (EEM) for broilers is an example of a set of statistical models.[12] In the draft EEM, EPA presented three models of increasing complexity that used between 11 and 31 regression coefficients, including average bird mass, confinement clean-out history, temperature, and humidity.[13] Whether process-based or statistical, emissions models can only be used when all of the input variables can be quantified. This is often not possible. For example, we may want to estimate how much ammonia a planned, but not yet built, broiler CAFO will emit. We will know some things, like the number of chickens that the barns can hold, but we would only be guessing about variables like pounds of broilers produced each year, the schedule of barn cleanouts, and weather. Or we may be interested in aggregate emissions for a large, diverse area like the Chesapeake Bay watershed. Given the data and computational limitations at that scale, a complex emissions model may be too difficult to implement.

The simplest way to estimate emissions is to use an "emissions factor." Emissions factors are basic coefficients, expressed (for broilers) as some variation on 'pounds of ammonia per chicken.' Emissions factors can be derived from monitoring data or models, but in either case they are meant to approximate an average facility. Emissions factors are less precise than detailed models, but on the other hand they are easier to use, and they can produce reasonably accurate emissions totals, particularly for large areas like states or the Bay watershed.

In the case of broiler confinements, emissions factors might have one of three denominators:

- **Inventory:** The EPA has traditionally used an inventory-based emissions factor, described in more detail below, in the form of kilograms of ammonia per broiler per year, or kilograms of ammonia per broiler per month, with broiler "inventory" being the average population of broilers in a confinement, or the capacity of broiler barns at a confinement. At the county or state level, inventory statistics can be found in the USDA Census of Agriculture, which is compiled every five years.[14]

- **Production (Sales):** It may be preferable to estimate emissions based on production rather than inventory. There can be several cycles or flocks of broiler production over the course of a year. For example, in 2012, Maryland had an average statewide broiler inventory of 64.2 million broilers, but it produced (sold) 304.7 million birds (Appendix A), suggesting that there were, on average, about five flocks of broilers at each confinement. In order to account for differences in the number of flocks per year – differences that are not apparent in basic inventory statistics – ammonia emissions can be approximated as "pounds of ammonia per broiler sold."[15]

- **Production (Weight):** Not all broilers are the same weight when they are sold. For example, the average broiler in Delaware weighs almost twice as much as the average broiler in West Virginia (see Appendix A). And we know that larger broilers excrete more ammonia. So a third emissions factor would be expressed as "pounds of ammonia per pound of broiler sold" over the course of a year.

In the discussion that follows we attempt to derive all three types of emissions factor from available monitoring studies.

EPA Emission Factors

The EPA has historically used an inventory-based emissions factor. Athough the Agency has chosen to express the factor in different ways, the factor itself was constant from as early as 2004 through at least 2011.

In 2004, EPA published a draft report documenting the technical basis for its National Emissions Inventory (NEI). At that time, EPA expressed the ammonia emissions factor for broiler confinements as 0.22 pounds of ammonia per broiler per year (0.22 lb NH_3/head/yr).[16] It is important to note that this emissions factor was derived entirely from European studies.[17] American and European agricultural practices (and meteorological conditions) are quite different. European broiler operations tend to replace the litter after each flock, while American broiler operation reuse litter for up to a year.[18] European operations generally grow lighter birds.[19] Temperatures in Europe are cooler.[20] All of these factors cause American broiler emission rates to be significantly greater than European emission rates. Wheeler et al. (2006) presented seven American estimates alongside seven European estimates.[21] The mean ammonia emissions rate from the American studies was 0.64 pounds per broiler per year, three times higher than the mean from the European studies (0.21 pounds per broiler per year).[22]

In the documentation for the 2011 NEI, EPA stated that it was using Carnegie Mellon's emissions model, but it listed a single emissions factor for broiler confinements.[23] The new emissions factor – 8.32E-03 kg NH_3/bird-month – is, after converting kilograms to pounds and months to years, equal to the old emissions factor. In the documentation for the 2014 NEI, EPA claims to have changed the way it uses the Carnegie Mellon model to estimate poultry emissions, but there is no evidence that the emissions factor for broiler confinements has changed.[24]

For purposes of EPA's Chesapeake Bay model, the Agency is using the 2011 NEI for at least part of its simulations,[25] and maybe for all of its simulations.[26] In short, it appears that

EPA continues to assume that broiler confinements emit 0.22 pounds of ammonia per broiler per year, an assumption based on outdated European data. As discussed in detail below, that assumption is probably far too low.

Monitored emissions from broiler houses: Total emissions

Ammonia emissions from broiler houses have been measured many times, in different locations (inside and outside the United States) and using different methods. We reviewed studies from within the United States in order to evaluate whether the current EPA emissions factor is still valid, and in order to approximate a more reasonable emissions factor. As a preliminary matter, it is important to note that some studies attempted to capture the full cycle of a broiler confinement, including the cleanout period that can cause a pulse in ammonia emissions, while other studies only looked at emissions while there were broilers in a barn. This section only looks at the studies that monitored the total emissions over full cycles, including the periods between flocks. The following section discusses studies that only looked at the grow-out period.

NATIONAL AIR EMISSIONS MONITORING STUDY (NAEMS)

Between 2007 and 2009, researchers working with the EPA monitored the emissions of ammonia and other pollutants from four broiler houses, two in California and two in Kentucky.[27] Ammonia emissions were calculated by subtracting ambient air concentrations from exhaust air concentrations. In 2012, EPA released a draft Emissions-Estimating Methodology (EEM) for broilers.[28] In that 2012 document, EPA provided the following simple summary statistics that include all periods (growout, decaking, and full cleanout):

Table 2: Summary ammonia data for NAEMS broiler studies.[29]

	Average house inventory	Average daily emissions (lb/d-house)	Grams per day per bird
California barn 1	21,000	22.49	0.49
California barn 2	21,000	19.82	0.43
Kentucky barn 1	23,000	26.76	0.53
Kentucky barn 2	24,500	27.29	0.50

It is also possible to represent NAEMS emissions as a function of broiler production statistics. The Kentucky study derived a sales-based emissions factor of 35.4 grams of ammonia per bird marketed,[30] and a weight-based factor of 12.5 grams of ammonia per kilogram of broiler.[31] The study of California barns did not provide comparable estimates, but the California study did provide daily data on bird counts and bird weight, from which we can estimate production statistics. Appendix B provides an example of the data, and explains how we derived emissions factors from the data. Based on the raw data, it appears that production-based emissions factors for the California study would be 29 grams of ammonia per bird marketed, and 11 grams of ammonia per kilogram of broiler.

MOORE ET AL. (2011)

Moore et al. monitored four broiler barns in Arkansas in 2005 and 2006, over five flock cycles, including the periods between flocks.[32] The authors present a production-based emissions estimate of 37.5 grams of ammonia per bird,[33] and they also provide average bird weight (2.582 kg), from which a weight-based estimate can be derived (14.5 grams of ammonia per kg of broiler). In order to translate these values into an inventory-based estimate, we had to make two calculations. First, since inventory generally refers to the number of birds placed in a barn, rather than the number that survive to be sold, and the broiler in this study had a mortality rate of roughly 4 percent, we had convert 37.5 grams of ammonia per bird *sold* to 35.9 grams of ammonia per bird *placed*. Second, we had to determine how many days of emissions each bird was responsible for, including both the grow-out and the between-flock periods. The authors provide start dates for each of the five flocks in their study, from which we were able to calculate the lengths of the first four flock cycles (from one start date to the next).[34] The average flock cycle was 70.5 days. An inventory-based emissions factor would therefore be roughly 35.9 grams per bird divided by 70.5 days, or 0.51 grams of ammonia per bird per day.

Table 3: Summary of monitoring data and emissions factors for the full broiler cycle, including both grow-out and between-flock periods

Source	Location	No. of barns	Average age of flock (days)	Average flock size (per barn)	Average market weight (kg)	g NH3/bird-day	g NH3/bird sold	g NH3/kg market weight
EPA (2012)	CA	2	47.0[35]	21,000[36]	2.65[37]	0.46[38]	29.0[39]	11.0[40]
EPA (2012)	KY	2	51.5[41]	25,100[42]	2.76[43]	0.52[44]	35.4[45]	12.5[46]
Moore et al. (2011)	AR	4	50.4[47]	26,300[48]	2.58[49]	0.51[50]	37.5[51]	14.5[52]

Monitored Emissions from Broiler Houses: Grow-Out Period Only

Several studies have measured ammonia emissions during the grow-out period only (i.e., not during the between-flock barn cleanouts). Lacey et al. (2003) measured ammonia emissions from four broiler houses in Texas in 2000, and derived an emissions factor of 31 grams of ammonia per bird.[53] Siefert et al. have published two studies on the Delmarva peninsula with quite different results. The first study, published in 2004, derived an emissions factor of 38 grams of ammonia per bird, while the second study, published in 2008, derived an emissions factor of just 5 grams of ammonia per bird. The authors attribute the difference in part to the fact that the newer study took place at a tunnel-ventilated broiler barn, while the earlier study took place at a side-wall ventilated house.[54] Yet all of the studies in Table 4, below, with the exception of the 2004 Siefert et al. study, were conducted at tunnel-ventilated houses, and all show much higher emissions rates. The 2008 Siefert and Scudlark study appears to be an outlier for some other reason, which may include errors in the analysis. Wheeler et al. (2006),[55] in a study funded by the U.S. Department of Agriculture, measured ammonia emissions from twelve barns in Pennsylvania and Kentucky in 2002 and 2003. The authors only assessed emissions during the grow-out period, but found a relatively wide range of daily emissions rates, from 0.47 to 0.98 grams of ammonia per bird per day. Miles et al. (2014) measured ammonia emissions from a single barn in Mississippi in 2007 over the course of five flocks.[56]

Table 4: Summary of monitoring data and emissions factors for only the grow-out period

Source	Location	No. of barns	Average age of flock (days)	Average flock size (per barn)	Average weight (kg)	g NH3/ bird-day	g NH3/ bird sold	g NH3/kg market weight
Lacey et al. 2003[57]	TX	4	49	27,500	2.4	0.63[58]	31.0	12.9[59]
Siefert et al. 2004[60]	MD	1	42	11,155	*not available*	0.90[61]	37.8[62]	*not available*
Wheeler et al. 2006[63]	PA	4	42	32,600	2.2	0.56[64]	23.5[65]	10.7[66]
Wheeler et al. 2006[67]	KY	4	56	22,500	2.9	0.87[68]	49.5[69]	16.8[70]
Siefert and Scudlark 2008[71]	Delmarva Peninsula	1	42	18,600	*not available*	0.12[72]	5.2[73]	*not available*
Miles et al. 2014[74]	MS	1	43	27,860	2.27	0.54	23.5	10.4[75]

The studies that monitored total, full-cycle emissions (Table 3) also segregated emissions between the grow-out and between-flock periods, which allows us to derive scaling factors between grow-out emissions and total emissions. For production-based emissions factors, the scaling factor will be a multiplier that increases the emissions factor, because each broiler is responsible for between-flock emissions that are always additive to grow-out emissions. For an inventory-based emissions factor, the scaling factor could theoretically result in an increase or a decrease in the amount of ammonia emitted per bird per day. Although peak emissions during the clean-out or decaking of a barn will often be higher than peak emissions during the grow-out period, the average daily emission rate over the entire between-flock period may be lower than the average daily emission rate during the grow-out period. Tables 5 and 6 compare grow-out and total emissions from studies with available data. These tables show that total emissions are roughly 21% higher than emissions from the grow-out period only, and that the total daily emissions rate over the entire flock cycle is roughly 7% lower than the daily emissions rate during the grow-out period.

Table 5: Total emissions compared to emissions for the grow-out period

Study	Grow-out emissions	Total emissions	Total emissions / grow-out emissions
Moore et al. (2011)[76]	28.37 g NH_3/bird	37.46 g NH_3/bird	1.32
EPA (2012), California barns[77]	4,049.48 kg NH_3	4,466.41 kg NH_3	1.10
EPA (2012), Kentucky barns[78]	3,619.62 kg NH_3	4,373.08 kg NH_3	1.21
Average ratio (scaling factor)			***1.21***

Table 6: Total emissions rates compared to emissions rates for the grow-out period

Study	Grow-out emissions rate, g/bird-day	Total emissions rate, g/bird-day	Total emissions rate / grow-out emissions rate
Moore et al. (2011)[79]	0.56[80]	0.51[81]	0.91
EPA (2012), California barns[82]	0.50[83]	0.46[84]	0.92
EPA (2012), Kentucky barns[85]	0.56[86]	0.52[87]	0.95
Average ratio (scaling factor)			***0.93***

Using the scaling factors shown in Tables 5 and 6, we combined the emissions estimates from Table 3 with adjusted emissions estimates from Table 4 to derive average emissions factors from all of the literature values. Table 7 shows this derivation.

Table 7: Combined emissions factors

Study	Grams of ammonia per bird, per day	Grams of ammonia per bird marketed	Grams of ammonia per kg of market weight
EPA (2012),[88] CA	0.46	29.0	11.0
EPA (2012), KY	0.52	35.4	12.5
Moore et al. (2011)[89]	0.51	37.5	14.5
Lacey et al. (2003)[90]	0.59	37.5	15.6
Siefert et al. (2004)[91]	0.84	45.7	*not available*
Wheeler et al. (2006),[92] PA	0.52	28.4	13.0
Wheeler et al. (2006), KY	0.81	59.9	20.3
Siefert and Scudlark (2008)[93]	0.11	6.3	*not available*
Miles et al. (2014)[94]	0.50	28.4	12.6
Average value	**0.54**	**34.3**	**14.2**

Note: Highlighted cells are based on values in Table 4, but adjusted with the scaling factors shown in Tables 5 and 6.

The studies shown in Table 7 are mutually consistent, which increases the reliability of the combined estimates. Most studies predict daily emissions of between 0.4 and 0.6 grams of ammonia per bird. The lowest (0.11 grams per bird per day) and highest (0.84 grams per bird per day) estimates were both generated by Siefert et al., and do not change the overall average value. Similarly, total emissions are generally in the range of 30-60 grams of ammonia per bird, or 10-20 grams of ammonia per kilogram of broiler weight. In short, the range of estimates is generally within a factor of two, which is comparable to (or better) than the data used to develop emissions factors for most other industries.[95]

Broiler Emissions in the Chesapeake Bay Watershed

Using the emissions factors derived in the preceding sections and the broiler statistics shown in Appendix A, we estimated the ammonia emissions from broiler confinements in the Chesapeake Bay states in 2002, 2007 and 2012 (all years for which broiler inventory data are available), and also 2016 (the most recent year with production statistics). Table 8 compares our estimates with emissions estimated using the most recent obtainable EPA method (the 2011 NEI method). It should be noted that the 2011 NEI method and our inventory-based emissions factor can be directly compared, as they both use broiler inventory statistics. The NEI method is equivalent to 0.27 grams of ammonia per bird, per day. Based on the monitoring data described above, EPA's NEI factor is much too low, and the true factor should be roughly twice as large, at 0.54 grams of ammonia per bird, per day. Total emissions estimates presented in Table 8 reflect this difference.

Table 8: Ammonia emissions (tons) from broiler confinements in the Chesapeake Bay states using different emissions factors

	2011 NEI method	Emissions factors derived from monitoring data, as described above		
Year	8.32E-03 kg NH_3/bird-month	0.54 g NH_3/bird-d	34.3 g NH_3/bird marketed	14.2 g NH_3/kg of market weight
2002	19,370	38,239	38,944	37,460
2007	22,088	43,605	38,981	40,314
2012	20,888	41,237	38,339	40,861
2016			41,628	47,009

Table 8 shows that broiler confinements in the Chesapeake Bay watershed emit roughly 40,000 tons of ammonia each year, and that the amount is increasing over time. The three emissions factors that we derived produce roughly comparable results, within 5 or 10 percent of each other, for any given year. Table 8 also shows that the NEI emissions factor for broiler operations is outdated and too low, estimating half as much ammonia as the three factors that we derived.

Discussion

We estimate that broiler confinements in the Chesapeake Bay watershed emit roughly 40,000 tons of ammonia each year. For comparison, the 2014 NEI estimated that ammonia emissions from all livestock waste totaled 96,000 tons,[96] and EPA's most recent estimate of ammonia *deposition* in the watershed is 81,000 tons.[97] Broilers are clearly a large part of the ammonia problem, and it is important that the Bay model get this part of the puzzle right. An outdated emissions factor based on European agricultural practices is not the right fit for today's Chesapeake Bay.

It helps to frame these estimates in terms of a typical broiler CAFO. We have previously reported on data found in "Annual Implementation Reports" for broiler CAFOs on Maryland's Eastern Shore.[98] Based on these reports, a typical Eastern Shore broiler CAFO might have an inventory of 110,000 broilers and raise 4.8 flocks per year. If we assume 3% mortality,[99] this CAFO would produce 512,160 broilers per year, at an average weight of about 6 pounds (see Appendix A), thus producing just over 3 million pounds of broilers per year. According to the 2011 NEI emissions factor, this CAFO would emit 12 tons of ammonia per year. According to the emissions factors that we derived, this CAFO would actually emit between 19 and 24 tons of ammonia per year.

Our estimates are based on monitoring studies, but they agree well with mass-balance estimates of ammonia emissions. Coufal et al. (2006) measured all nitrogen inputs and outputs over eighteen flocks at a Texas broiler barn.[100] Overall, these authors determined that ammonia losses totaled 13.5 grams per kilogram of broiler weight,[101] very close to our estimated emissions factor of 14.2 grams per kilogram (Table 7).

The use of litter amendments can help to reduce ammonia emissions to some degree. For example, in a doctoral dissertation on this topic, Senyondo found that small experimental broiler flocks treated with a biodegradable litter amendment made from corn cobs had ammonia emission that were, on average, 27% lower than control flocks.[102] The effectiveness diminished over the course of five flocks as the litter was left in place, and by the fifth flock the treatment emissions were actually higher than the control emissions.[103] Another study evaluated the effectiveness of three alum treatments, and found that average weekly emissions were between 9 and 34% lower from alum-treated barns than from a control barn.[104]

Some of the studies that we included in this report did not use litter amendments (e.g., the EPA NAEMS study), others included a mix of barns that did or did not used litter amendments (e.g., Wheeler et al., 2006),[105] and others did not specify whether amendments were used. If the use of litter amendments is more widespread in the Chesapeake Bay watershed than it was in the studies we evaluated, then actual emissions may be slightly lower than we predict. However, this variable does not significantly affect our conclusions: We do not know the extent of litter amendment in the Bay watershed, but even if its use is widespread, the resulting reduction in emissions is presumably less than a third (since at least some of the data in this report was based on amended litter). This means that even in a best-case scenario, emissions are still significantly higher than EPA has traditionally assumed.

Given the possibility that EPA is underestimating a significant component of the Chesapeake Bay's nitrogen load, the Agency should more clearly explain how much ammonia it assumes to be escaping from broiler confinements. If EPA is still relying on outdated emissions factors based on European agricultural practices, it should revise its assumptions to reflect what we now know about ammonia emissions from American broiler operations.

Appendix A: Broiler statistics for the Chesapeake Bay Watershed

Data for inventory and birds sold through 2012 are from the USDA Census of Agriculture, which is compiled every five years.[106] Data for pounds of broilers produced, and for birds sold in 2016, are from USDA Poultry Production and Value summaries, which are produced each year.[107]

Table A1: Inventory and production of broiler chickens in Chesapeake Bay states

Inventory (millions of birds)	MD	VA	PA	DE	WV	TOTAL
2002	51.1	45.4	21.6	45.6	12.2	176.0
2007	65.5	43.7	27.5	51.1	12.8	200.7
2012	64.2	38.4	29.2	43.2	14.8	189.8
Production (millions of birds sold)	MD	VA	PA	DE	WV	TOTAL
2002	287.1	266.1	132.5	255.9	88.7	1,030
2007	296.4	249.2	150.1	246.1	88.8	1,031
2012	304.7	237.7	166.7	211.6	93.7	1,014
2016	303.5	269.1	185.7	252.5	90.3	1,101
Production (millions of pounds)	MD	VA	PA	DE	WV	TOTAL
2002	1,381.4	1,330.4	701.2	1,494.7	368.2	5,276
2007	1,591.9	1,301.0	831.6	1,597.7	355.6	5,678
2012	1,604.8	1,306.8	962.1	1,505.2	376.0	5,755
2016	1,851.4	1,533.9	1,039.9	1,843.3	352.2	6,621
Average bird size (lbs)	MD	VA	PA	DE	WV	AVERAGE
2002	4.8	5.0	5.3	5.8	4.2	5.1
2007	5.4	5.2	5.5	6.5	4.0	5.5
2012	5.3	5.5	5.8	7.1	4.0	5.7
2016	6.1	5.7	5.6	7.3	3.9	6.0

APPENDIX 4, EXHIBIT I

<u>Acres of Freshwater and Estuarine Wetlands and Waters on Maryland's Eastern Shore as Estimated by the Chesapeake Bay Model</u>
(R. at 0485.)

This exhibit shows the number of acres of wetlands and surface waters on Maryland's Eastern Shore from the Chesapeake Bay Model, as discussed in the Administrative Record on page 0485 and referenced in the memorandum of law on page 10.

To access this information, see:
https://cast.chesapeakebay.net/.

Data Source Version	CAST-2019
File Creation Date	10/06/2020
Base Conditions Report	This report provides information on the base conditions utilized for the selected scenario, including load source acres, septic systems, animal counts, and nutrients applied. Definitions are available https://cast.chesapeakebay.net/Reports/RetrievePublicReport?reportType=1

Row Labels	**Headwater or Isolated**	**Non-tidal Floodplain Wetland**	**Water**	**Acres**
Caroline, MD	21,185	6,111	3,098	**30,394**
Cecil, MD	1,096	2,348	4,642	**8,086**
Dorchester, MD	11,148	1,575	31,819	**44,541**
Kent, MD	5,311	4,325	5,660	**15,297**
Queen Annes, MD	16,281	10,249	5,012	**31,542**
Somerset, MD	26,757	1,761	11,650	**40,168**
Talbot, MD	5,545	1,911	5,138	**12,593**
Wicomico, MD	22,698	12,136	5,709	**40,543**
Worcester, MD	16,683	42,790	2,659	**62,132**
Grand Total	**126,703**	**83,206**	**75,388**	**285,297**