

**Responses to Additional Significant Comments on the
2024 Proposed Action on the
Secondary National Ambient Air Quality Standards for
Oxides of Nitrogen, Oxides of Sulfur and Particulate Matter
(April 15, 2024; 89 FR 26620)**

Docket Number EPA-HQ-OAR-2014-0128

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Table of Contents

Frequently Cited Documents	iv
I. Introduction.....	1
II. Comments on Review of the Secondary Standards	2
III. Comments on Implementation.....	8
IV. Legal, Administrative, and Procedural Issues and Misplaced Comments.....	9
References.....	19

Appendix A. List of Abbreviations and Acronyms

Appendix B. Clean Air Act Class I Areas in Ecoregions included in the Aquatic Acidification
Risk and Exposure Assessment

Frequently Cited Documents

The following documents are frequently cited throughout the EPA's response to comments, often by means of the short names listed below:

Integrated Science Assessment (ISA)

U.S. EPA (2020). Integrated Science Assessment (ISA) for Oxides of Nitrogen, Oxides of Sulfur and Particulate Matter Ecological Criteria (Final Report, 2020). Office of Air Quality Planning and Standards, Research Triangle Park, NC. EPA/600/R-20/278. September 2020. Available at: <https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P1010WR3.PDF>.

Policy Assessment (PA)

U.S. EPA (2024). Policy Assessment for the Review of the Secondary National Ambient Air Quality Standards for Oxides of Nitrogen, Oxides of Sulfur and Particulate Matter. Office of Air Quality Planning and Standards, Research Triangle Park, NC. EPA-452/R-24-003. January 2024. Available at: <https://www.epa.gov/system/files/documents/2024-01/noxsoxpm-final.pdf>.

Proposed Rule (Proposal)

Review of the Secondary National Ambient Air Quality Standards for Oxides of Nitrogen, Oxides of Sulfur, and Particulate Matter: Proposed Rule. 89 FR 26620, April 15, 2024.

Preamble to the Final Rule

Preamble to the Final Rule on the Review of the Secondary National Ambient Air Quality Standards for Oxides of Nitrogen, Oxides of Sulfur, and Particulate Matter: Final Rule. To be published in the *Federal Register*.

Responses to Significant Comments on the 2024 Proposed Action on the Secondary National Ambient Air Quality Standards for Oxides of Nitrogen, Oxides of Sulfur and Particulate Matter

I. Introduction

This document, together with the *Federal Register* notice of final decisions on the review of the secondary national ambient air quality standards (NAAQS) for oxides of nitrogen (N oxides), oxides of sulfur (SO_x), and particulate matter (PM), presents the responses of the Environmental Protection Agency (EPA) to some of the public comments received on the April 2024 proposal notice (89 FR 26620, April 15, 2024). All significant issues raised in timely public comments have been addressed. Where comments were submitted after the close of the public comment period, the EPA has responded to the extent practicable.

The responses presented in this document are intended to address comments not discussed in the final decision notice. Although portions of the final decision may be paraphrased in this Response to Comments (RTC) document, to the extent such paraphrasing introduces any confusion or apparent inconsistency, the preamble itself remains the definitive statement of the rationale for the decisions in the final action. This document, together with the preamble to the final decision notice in the review of the secondary NAAQS for ecological effects of N oxides, SO_x, and PM and the information contained in the Integrated Science Assessment (ISA, U.S. EPA, 2020), the Policy Assessment (PA, U.S. EPA, 2024), and related technical support documents, should be considered collectively as the EPA's response to all of the significant comments submitted on the EPA's April 2024 proposed decisions.¹

Section II addresses public comments related to review of the secondary standards. Significant comments related to implementation are addressed in Sections III. Lastly, section IV includes responses to legal, administrative, procedural, or misplaced comments.

¹ The docket for this review is EPA-HQ-OAR-2014-0128.

II. Comments on Review of the Secondary Standards

This section addresses public comments related to the EPA's review of the secondary standards for SO_x, N oxides and PM.

(1) Comment: One comment expressed the view that EPA, in its review of the secondary standards for SO_x, N oxides and PM, should consider how future climate change may affect effects of SO_x, N oxides and PM, which the commenter suggested potentially could be exacerbated. The comment suggested that the EPA could include an analysis that addresses how climate could interact with SO_x, N oxides and PM emissions and deposition and that addresses uncertainty about climate effects on ecological conditions. In this context the comment references a statement from the CASAC that recent research implies "the uncertainty associated with relying on past research to predict future welfare effects is increasing, and that it is essential to incorporate the climate reality into decision-making."

Response: The available evidence related to influence of future climate change on ecosystem effects of N and S deposition, with a primary focus on N, is discussed in the ISA (ISA, Appendix 13). This assessment recognizes the influence of temperature and precipitation on ecosystem processes involving N cycling and indicates the potential for climate change, through changes in temperature and precipitation patterns, to alter N cycling with associated influence on its effects (ISA, Appendix 13, section 13.1). This potential contributes additional uncertainty to consideration of N deposition related to N oxides and PM and associated decisions on standards. As described in section II.B.3 of the Preamble to the Final Rule, after consideration of the full evidence base (including this information), the Administrator has decided to retain the existing standards for N oxides and PM in consideration of an array of factors related to consideration of N deposition-related effects of these pollutants. The EPA will continue to evaluate the impact of future climate change on the adverse effects associated with these criteria pollutants to the extent possible and consistent with available science in future reviews.

(2) Comment: One comment provided a list of publications that they indicated should be considered in the EPA's decision on the standards in this review. In so doing, they note that the ISA was based on literature published up to 2017 which resulted in omission of some publications (published after 2017) that they suggested could better inform the standards decision.

Response: The commenters' list includes 12 publications that are among those identified in public comments that were not included in the ISA and that the EPA has provisionally considered (Weaver, 2024). Based on this provisional consideration, the EPA concluded that none of the studies that were provisionally considered (including those listed in this comment) materially change any of the broad scientific conclusions of the ISA or warrant reopening the air quality criteria for this review, as described in section I.D of the Preamble to the Final Rule.

In expressing the view that the studies identified should be considered in the Administrator's decision, the commenter did not indicate in what way the publications would be critical. We note that the studies cover a range of topics: two are on haze or visibility effects (Lv et al.,

2022; Malm et al., 2019); two concern mercury, aquatic chemistry and bioavailability to dragonflies (Akerblom et al., 2020; Nelson et al., 2024);² one concerns ANC levels in mountain streams (Burns et al., 2020); three are studies about N loading to Chesapeake Bay (Baker et al. 2019; Burns et al., 2021; Campbell et al., 2019); three are observational studies on terrestrial species richness and S or N deposition (Clark et al., 2019; Geiser et al., 2019, 2021); and the last concerns chemical constituents of cloud water at a mountain location (Lawrence et al., 2023).

With regard to the studies related to assessing haze or impacts on visibility, as recognized throughout this review of the secondary standards for ecological effects of N oxides, SO_x and PM (including in the notices of proposed and final decisions), effects on visibility are not within the scope of this review (IRP, pp. 1-2 and 2-1; PA, pp. 1-1, 1-14 and 3-2; 89 FR 26620, April 15, 2024).

The three mercury studies and the study on ANC levels concern topics that are addressed in the ISA. For example, the three mercury studies include one that discusses ecological effects of Hg pollution and related effects on ecosystem services, a second investigating the influence of SO₄ concentrations in peat pore water on methylmercury levels, and a third reporting on the influence of dissolved organic carbon and SO₄ level in different ecosystems on mercury bioavailability to dragonflies. The ANC study reports on ANC levels in Appalachian streams under conditions of varying flow rates. As concluded by the provisional consideration of these studies, they do not affect the broad scientific conclusions of the ISA which include the findings of causal determinations between S deposition and the alteration of mercury methylation in freshwater ecosystems and between acidifying N and S deposition and effects in freshwater ecosystems (ISA, Table ES-1). Nor do we find these studies to offer information that would substantively affect the EPA's decisions on NAAQS to address acidic deposition, and specifically S deposition.

Similarly, the three N loading studies (presenting modeling of past and projected future N loading to Chesapeake Bay watershed), the three observational studies and the study of cloud water composition, while providing further information regarding contributors to N deposition, atmospheric chemistry of N and S compounds, and statistical relationships between ecological and deposition metrics, do not materially change conclusions of the ISA, and also do not provide information that would alter the conclusions drawn from the evidence base in this review. Accordingly, the EPA has considered these studies and finds that they do not offer information that would substantively affect the EPA's decisions in this review.

(3) Comment: One comment expressed the view that in considering impacts of S and N deposition on public welfare, EPA should consider other public benefits including visibility, implications for conditions conducive to Hg methylation (referencing consideration of socio-economic impacts of Hg pollution on fisheries and livelihoods from the Minamata Convention on Mercury). The comment also recommended that EPA consider how protected

² The comment additionally mentions impacts of mercury on ecosystem services and fisheries in citing a Minamata Convention website from which many links and documents are available, but does not identify a specific publication for consideration.

wilderness areas, such as Class I³ areas, are impacted and that sensitive ecosystems should be weighed in standards decisions. The comment additionally stated small headwater streams can be more vulnerable to S and N deposition impacts and provide a number of ecosystem services.

Response: As an initial matter, EPA notes that the visibility effects of PM were considered in the 2020 review of the PM_{2.5} NAAQS, and the recently completed reconsideration of the 2020 decision (89 FR 16202, March 6, 2024). As recognized throughout this review of the secondary standards for ecological effects of N oxides, SO_x and PM (including in the notices of proposed and final decisions), visibility and climate are not within the scope of this review (IRP, pp. 1-2 and 2-1; PA, pp. 1-1, 1-14 and 3-2; 89 FR 26620, April 15, 2024).

With regard to conditions conducive to Hg methylation, the EPA agrees that Hg contamination of the waterbody and associated fisheries would have public welfare implications, and that these include socio-economic impacts related to affected fisheries. We note that the assessment of the ecological effects evidence in this review determined that S deposition is causally related to the alteration of mercury methylation in surface water, sediment and soils in freshwater ecosystems (ISA, Appendix 12, section 12.7). As described in the Preamble to the Final Rule, the Administrator's final decision in this review is to revise the existing SO₂ standard to address S deposition-related effects. While the primary focus of the decision was on the evidence and exposure/risk information regarding ecosystem acidification effects, other effects considered in reaching this decision included those related to mercury methylation in freshwater ecosystems (for which quantitative tools and approaches are not sufficiently developed to support quantitative analyses).⁴ Accordingly, the control of S deposition associated with the newly revised SO₂ standard will provide benefits associated with reduction of the risk of all S deposition-related effects, including the risk of effects on freshwater ecosystems related to mercury methylation.

With regard to wilderness areas, including such areas that are, or are in, Class I areas, we agree that protection of such areas is important to protection of the public welfare, as recognized in section II. A.3.b of the Preamble to the Final Rule. Further, each of the acid-sensitive ecoregions included in the REA for this review include Class I areas, such that 65 Class I areas across the U.S. have been part of the aquatic acidification risk analysis (see table in Appendix B). The aquatic acidification REA was a critical aspect of the Administrator's decision to revise the SO₂ standard and of his decision on the necessary stringency of the standard to provide the requisite protection from S deposition-related effects. Thus, the benefits of this decision accrue to the many Class I areas in acid-sensitive ecoregions across the U.S. As recognized in the ISA, small or headwater streams are among

³ Areas designated as Class I include all international parks, national wilderness areas which exceed 5,000 acres in size, national memorial parks which exceed 5,000 acres in size, and national parks which exceed 6,000 acres in size, provided the park or wilderness area was in existence on August 7, 1977. Other areas may also be Class I if designated as Class I consistent with the CAA.

⁴ Factors affecting the development of approaches include that the rate of mercury methylation varies with the type and salinity of waterbody and according to several spatial and biogeochemical factors whose influence has not been fully quantified (ISA, Appendix 12, sections 12.3 and 12.8). As a result, quantitative analyses of the relationships between sulfur deposition and methylmercury production could not be quantified.

those that are sensitive to acidification in the East, particularly with regard to episodic acidification (ISA, Appendix 8, section 8.5.1), and such streams are among the many waterbodies included in the aquatic acidification REA, the results of which are a key aspect of the basis for the Administrator's decision on the NAAQS for SO_x. Therefore, the need to provide requisite protection for these sensitive waterbodies was taken into consideration and was part of the rationale for the newly revised standard.

(4) Comment: A comment received stated that the EPA should evaluate “pollutant levels holistically rather than in isolation,” and that EPA needs to be clear on which impacts it has considered, suggesting that EPA clarify what other impacts for which there are causal relationships with the pollutants in this review could benefit from a strong acidification standard.

Response: As an initial matter, we note that contrary to the implication of the commenter that this review considers pollutants in isolation, this is a combined review of three criteria pollutants and the three pollutants were not considered in isolation. Additionally, each of these three criteria pollutants – SO_x, N oxides and PM – comprises multiple individual chemicals that occur in ambient air (PA Figure 2-1). For example, the ISA identifies five different sulfur oxides and many N oxides that can occur in ambient air (ISA, Appendix 2, section 2.1). Particulate matter is comprised of hundreds of chemicals, some of which, as discussed in ISA, PA, proposal and the Preamble to the Final Rule are S or N-containing substances (ISA, Appendix 2, section 2.1). Further, some gaseous N oxides transform in the atmosphere into particulate compounds. For example, HNO₃, an oxide of nitrogen, can interact with NH₃ to form particulate NH₄NO₃ (ISA, Appendix 2, section 2.1). Also, in considering aquatic acidification effects, the EPA considered the contribution of both N and S compounds, with the REA finding that recent conditions are such that N deposition is a negligible contributor, relative to S deposition, to aquatic acidification risk. Accordingly, after reaching this conclusion, the PA and regulatory rulemaking in this review focused on S deposition in consideration of aquatic acidification risk (PA, Appendix 5A).

Further, in this review, the EPA has considered the available evidence for ecological effects of the three pollutants, including those related to S and N deposition in ecosystems, and the ISA presents causal determinations for multiple effects (ISA, Table ES-1). As discussed in section II.B.3 of the Preamble to the Final Rule, the Administrator has considered the array of effects in reaching his decisions on the three criteria pollutants included in this review. In considering potential revisions to the standard the EPA has considered the extent to which the information is sufficient for a basis of standard setting and focused on such effects that have the potential to be the most sensitive, as described in section II.B.3 of the Preamble to the Final Rule. In so doing, the resultant standard, while it is being established with a primary objective of providing strong protection against ecosystem acidification, is also judged to afford protection for the array of effects, as indicated by the available evidence, and discussed in section II.B.3 of the Preamble to the Final Rule.

(5) Comment: One comment claims that ammonium is not identified as a component of PM, a criteria pollutant and that explanation is needed for a lack of consideration of its contribution to N deposition. The commenter additionally claims that the Administrator, in the review of the N Oxides and SO_x secondary NAAQS, found the effects of N deposition to be adverse

and that in the proposal for the current review the Administrator determined that N deposition effects are not adverse, a determination for which the commenter states a more clear explanation is needed. In expresses these views, the commenter additionally claims that N deposition and related effects are dominated by the contribution from criteria pollutants to a greater extent than in the 2012 review of the N Oxides and SO_x secondary NAAQS.

Response: The EPA disagrees with the commenter that ammonium was not identified as a component of PM in this review, and notes that over the course of this review, ammonium has been repeatedly recognized as a component of PM (e.g., IRP, p. 1-2, PA, Chapters 2, 6 and 7;), and also in section II.B.1 of the proposal (89 FR 26631-26635, April 15, 2024). Additionally, the proposal, in its description of the review of the PM criteria and NAAQS, clearly considers PM, which includes ammonium, to be a criteria pollutant.

With regard statements by the Administrator in the 2012 and current review, we note that the Administrator did not in the proposed decision and has not in the final decision concluded that effects of N deposition are not adverse. Rather, the Administrator discussed the consideration of N deposition levels, in the PA and by the CASAC majority, that may be associated with welfare effects of concern. Further, however, the EPA has recognized that N deposition also results from NH₃, a pollutant that is not a criteria pollutant, and consequently is beyond the scope of this review. As discussed in the proposal and in the final decision notice, the Administrator recognizes that particulate NH₄⁺, a transformation product of NH₃, is a component of PM, but also recognizes that total N deposition in the U.S. includes a variable and significant component associated with a pollutant that is not a criteria pollutant (gaseous NH₃) and consequently is beyond the scope of this decision.

With regard to the commenter's comparison of the current review to 2012, the EPA disagrees that the EPA is taking a step backwards with regard to recognizing the ecological effects associated with N deposition. Rather, the larger evidence base evaluated in the current review provides further support and expands on the conclusions in the 2012 review. More specifically, the 2020 ISA explicitly and in detail reaches conclusions that N deposition is causally associated with a broad array of effects including but not limited to the effects referenced by the commenter (reduced biodiversity and declines in growth and survival of some species; ISA, Table ES-1). These findings are also summarized in the PA and the proposal in this review. The Administrator considered these findings in reaching his proposed conclusions (89 FR 26676-26677, April 15, 2024). In the final decision, the Administrator is not evaluating the adequacy of the existing secondary NAAQS with regard to the effects of total N deposition. Rather, consistent with the requirements of the CAA, he considers the effects of N deposition related to the criteria pollutants being reviewed and the appropriateness of the protection provided by the standards reviewed, as discussed in section II.B.3 of the preamble to the Final Rule.

With regard to the commenter's claim that the contributions of N oxides and particulate ammonium to total N deposition in the current review is greater than that in the 2012 review, we first note that the N deposition estimates considered in the 2012 review were largely based on model applications for 2002, with comparisons to the years 2003-2005 that concluded there was a general similarity (2009 REA, sections 3.2.3 and 3.3.3). After also considering estimates and wet deposition measurements for 2003-2005, the 2009 REA

concluded “overall, for each case study area, the amount of nitrogen deposition in 2002 is generally representative of current conditions” (2009 REA, p. 3-30). The total deposition estimates at that time relied on a different and less advanced modeling approach than that used in the current review (PA, section 2.5).

In contrast, the deposition estimates available in the current review are drawn from a vastly improved approach to integrating monitoring data with modeling applications. That notwithstanding, use of the more robust estimates based on the now available Total Deposition (TDep) methodology⁵ finds that deposition of oxidized N and ammonium, as nationwide average, has declined, from approximately 6.4 kg/ha-yr in 2000-2002 to 4.6 kg/ha-yr in 2019-2021, with contributions from ammonia, which is not a criteria pollutant, more than doubling (Sales et al., 2024). The technical analysis describes such a pattern in States and ecoregions across the U.S. (Sales et al., 2024) Thus, we disagree that the contribution of criteria pollutants to total N deposition is greater (either in absolute or relative terms) than it was at the time of the 2012 review.

(6) Comment: One commenter stated that “there is no evidence that PM_{2.5} is a relevant indicator for welfare effects,” while noting their view that it is appropriate for a health-based standard.

Response: The EPA has concluded in the Preamble to the Final Rule that PM_{2.5} would not be an effective indicator for addressing S or N deposition-related effects and therefore is not an appropriate indicator for a PM_{2.5} standard for such a purpose, as described in section II.B.3 of the Preamble to the Final Rule. It is, however, appropriate and is the indicator for two existing secondary standards, which were concluded in 2013 to provide protection from an array of welfare effects, most prominently visibility effects which are the basis for the existing 24-hour standard. That standard was most recently reviewed with regard to protection for those effects in the PM review completed in March 2024. The 2019 The PM_{2.5} indicator is well documented to be appropriate for a standard addressing visibility impairment, a welfare effect that the 2019 ISA for Particulate Matter determined to be causally related to PM in ambient air (89 FR 16313-16315, March 6, 2024; 2019 PM ISA, section 13.2.6). In reaching this conclusion, the PM ISA focuses on the quantitative evidence for PM_{2.5}. Thus, EPA recognizes that there are welfare effects for which PM_{2.5} is the appropriate indicator and disagrees with the commentator’s statement that there is no evidence that PM_{2.5} is a relevant indicator for welfare effects.

⁵ As described in detail in the PA, section 2.5.1, this methodology involves a hybrid approach based on a fusion of measured and modeled values, where measured values are given more weight at the monitoring locations and modeled data are used to fill in spatial gaps and provide information on chemical species that are not measured by routine monitoring networks. One of the outputs of this effort are annual datasets of total deposition estimates in the U.S. which are referred to as the TDep datasets which are available for the contiguous U.S.

III. Comments on Implementation

This section addresses comments on the EPA's discussion of implementation considerations in the proposal that are not addressed in the final decision notice.

- (1) Comment: The EPA received comments on various implementation topics and attainment planning topics. Topics included requests to provide additional implementation guidance for the secondary standard regarding general conformity, exceptional events, transport, Prevention of Significant Deterioration (PSD) permitting and the alternative PSD compliance demonstration. Additional topics included infrastructure State Implementation Plans (SIPs), transportation conformity, and general implementation, among other topics.

Response: Consistent with EPA's statements in the Proposed Rule, comments regarding implementation, including attainment planning, are outside the scope of this rulemaking, which is revising the secondary SO₂ NAAQS. In some instances, the comments regarded costs associated with implementation of the NAAQS. The EPA notes that under CAA Section 109(b)(1), the EPA is barred from considering costs in setting the NAAQS level. *Whitman v. American Trucking Associations*, 531 U.S. 457 (2001). To assist with implementation of the final revised secondary SO₂ NAAQS, EPA plans to issue the alternative compliance demonstration approach for purposes of PSD compliance demonstrations in a separate PSD-specific memorandum close in time to the effective date of the revised secondary SO₂ NAAQS.

- (2) Comment: The EPA received comments on various topics related to initial area designations and urged EPA to issue designations guidance in a timely manner.

Response: Consistent with EPA's statements in the NPRM, comments regarding initial area designations following promulgation of a new or revised NAAQS are outside the scope of this rulemaking, which is revising the secondary SO₂ NAAQS. As relevant and appropriate, the EPA expects to consider these comments as we develop a memorandum addressing initial area designations for the 2024 revised secondary SO₂ NAAQS. The EPA anticipates that the secondary SO₂ NAAQS designations memorandum will cover topics identified in the comments including schedule and timing for the designations process and exceptional events demonstrations.

IV. Legal, Administrative, and Procedural Issues and Misplaced Comments

A number of comments were received that addressed a wide range of issues including legal, administrative, and procedural issues, as well as issues that are not germane to the review of the NAAQS. Many legal issues are addressed generally throughout the notice of final action. Specific responses to other comments are presented below

- (1) Comment: One commenter states that the EPA was required to but did not conduct a consultation with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service under Section 7(a)(2) of the Endangered Species Act (ESA).

The commenter states that without such consultation the EPA cannot assure that any final standard is not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of critical habitat, and further states that Section 7 “consultation” is required under the ESA for “any action [that] may affect listed species or critical habitat” to “insure that any action authorized, funded, or carried out by such agency... is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the adverse modification of habitat of such species... determined...to be critical....” The commenter asserts that agency “action” is broadly defined in the ESA’s implementing regulations at 50 CFR 402.02 to include:

“(b) the promulgation of regulations; ... or (d) actions directly or indirectly causing modifications to the land, water, or air.” The comment states that the EPA’s review of the NAAQS is “an activity carried out by a federal agency in the United States which directly and indirectly causes modifications” to the land, water or air.

The commenter also indicates that the EPA’s review of the secondary NO_x, SO_x and PM NAAQS constitutes a “programmatic action” for which the commenter states the EPA must engage in “programmatic consultation” to consider cumulative impacts of the program and to guide implementation by establishing criteria to avoid, minimize or offset adverse effects on listed species and critical habitat. The commenter additionally states that project-specific consultations must then be undertaken for specific actions under the program.

The commenter also notes that ESA regulations at 50 CFR 402.03 provide that Section 7 of the ESA applies to all actions in which there is discretionary Federal involvement or control and asserts that the EPA has discretion to consider impacts to listed species in its review of the secondary NAAQS.

In this respect, the commenter states that the EPA’s review of the secondary NAAQS is a discretionary act by EPA, citing a statement in a Court of Appeals decision, and additionally states that the CAA both empowers and mandates the EPA to exercise its discretion to consider impacts to listed species and critical habitat in reviewing the secondary NO_x, SO_x and PM NAAQS because the secondary NAAQS is designed to protect the “public welfare,” which the CAA defines to include effects on soil, water, crops, vegetation, animals, wildlife, weather, visibility, and climate.

In asserting effects of SO_x, N oxides and PM on listed species, the commenter states that PM effects on climate result in effects on listed species, citing studies regarding the effects of climate change on various species or habitats.

In expressing the view that the subject pollutants may cause adverse effects on listed species, the commenter points to certain animal toxicological studies, which are not part of the criteria for this review and are beyond the scope of this review (some are included in the 2019 PM ISA [U.S. EPA, 2019] and the 2022 PM ISA Supplement [U.S. EPA, 2022]), that assess PM effects on lung growth and the nervous system in mice or rats; and states that the EPA should interpret the findings of various effects to show adverse effects on listed species in the same family or order, including listed rodent species. The commenter additionally asserts that the 2019 PM ISA failed to consider antibiotics and antibiotic-resistant bacteria in PM and states their view that one antibiotic, tetracycline, makes bees more susceptible to opportunistic pathogens and also reduces survivorship, citing a study, that is not in the 2019 PM ISA (or associated 2022 Supplement) or the ISA for the current review, that analyzed PM composition near cattle feed yards (McEachran et al., 2015). In light of these studies, the commenter states their view that PM may affect endangered bees as a result of antibiotic exposure, thus triggering consultation.

The commenter additionally describes a number of ecological effects related to NO_x and SO_x and acid rain and associated deposition, citing the ISA, and asserts that acid rain poses a major threat to many listed threatened and endangered species, and identifies a number of listed species that the commenter asserts are affected by this pollution. For each identified species, the commenter variously states that the identified species is susceptible to acidification or potentially affected by acid rain or acid deposition or increased acidity, and cites the Recovery Plan for that species.

Response: The EPA does not agree that leaving the secondary NAAQS for PM and N oxides unaltered triggers the requirement to consult under the ESA. Leaving the secondary NAAQS unchanged does not authorize or carry out any “action” under the statutory terms of the ESA.⁶ Both the Code of Federal Regulations and the status quo regarding secondary NAAQS are entirely undisturbed. Moreover, leaving the secondary NAAQS for PM and N oxides unaltered will not require the EPA to make new air quality designations, nor will it require states or authorized tribes to undertake new planning or control efforts or to change air quality for the secondary NAAQS.

Furthermore, The EPA disagrees with the commenter that EPA’s review of the secondary SO_x, N oxides and PM NAAQS is a programmatic activity that causes modifications to the land and water, and air, and that it thereby becomes an action subject to ESA section 7(a)(2) consultation. Even assuming that the ESA consultation requirement could apply to a decision to revise or retain the NAAQS, the EPA’s decisions in this review rulemaking will not cause any effects (within the meaning of 50 CFR § 402.02) for listed species or critical habitats,

⁶ Section 7(a)(2) of the ESA only applies to “action authorized, funded, or carried out” by a federal agency.

and therefore consultation with the Services is not required under section 7(a)(2) of the ESA and 50 CFR 402.14(a).

EPA is adopting a new annual secondary SO₂ NAAQS. However, as explained in the preamble and the docket memo, “Endangered Species Act No Effect Finding for Final Rulemaking on Secondary NAAQS for SO₂, NO₂, and PM” (Tennant et al., 2024), this standard is not being adopted in order to cause a change in current air quality, but to prevent potential future adverse effects that might result if emissions increased from current levels to levels permitted under the current standard. EPA has assessed current air quality and expects that air quality associated with meeting the current primary standard will meet the new secondary NAAQS, and also that current air quality conditions in the U.S. generally meet the new secondary NAAQS.⁷ EPA has therefore concluded that this new standard is not currently expected to result in any area of the country adopting new emissions controls. The memo also concludes (although air quality analysis is unnecessary for this conclusion) that the decision to retain the secondary NAAQS for PM and N oxides unaltered will not result in the implementation of additional emissions controls in any area.

Therefore, this rulemaking does not cause any reasonably certain effects on air quality (or associated environmental conditions) that could in turn have an effect on listed species or their habitat. Accordingly, EPA has made a determination, that this rule will have no effect on threatened and endangered species or their designated critical habitats (see Tennant et al., 2024).

Further, even if the ESA consultation requirement could apply, as a general matter, to the EPA’s decision to retain a secondary NAAQS, the ESA would not apply to this action for PM secondary standards as regards climate welfare effects because the EPA’s review of the secondary PM NAAQS has been bifurcated, and climate effects of PM, including effects on species and habitats, are not a part of this review, and that EPA is taking no action in this review regarding such effects. Rather, this review addresses ecological welfare effects. The climate effects of PM, as well as effects on visibility and materials damage, are beyond the scope of this review. As stated in both the PM IRP (U.S. EPA, 2016) and the IRP for N oxides, SO_x and PM (U.S. EPA, 2017), and in the preamble to the proposed rule, climate effects of PM (and effects on visibility and materials damage) were addressed in the review of the PM secondary standards completed in 2020, and reconsidered more recently (89 FR 16202, March 6, 2024). Conducting the PM NAAQS review in two separate phases is eminently reasonable and supported by considerations of atmospheric science.

⁷ EPA notes that there is currently (based on the 2023 certified SO₂ air monitoring data) one area of the country (represented by two monitors) that has ambient air concentrations of SO₂ that are estimated to exceed the new annual secondary NAAQS. However that area is already under an obligation to adopt a state implementation plan to attain the primary 1-hour SO₂ NAAQS and EPA’s analysis indicates that attainment of the primary NAAQS will result in attainment of levels well below the secondary NAAQS. Therefore, even if the area does not come into attainment with the annual standard before designations for that standard are issued, there is no reason to believe that additional emissions control measures will need to be adopted following designations for the new secondary standards in order to attain the secondary standard.

Although not directly relevant to EPA's conclusion with respect to consultation, EPA notes that it disagrees with the commenter that the toxicological rodent studies cited by the commenter as evidence of PM effects on listed species provide evidence pertaining to effects on listed species. These studies are toxicological studies using laboratory animal models. These strains are generally inbred over multiple generations and often genetically modified to focus on a particular aspect of mammalian physiological susceptibility with their use to inform an understanding of specific aspects of human susceptibility. These animals are not representative of wild animal populations of the species they originated from much less representative of wild animal populations of other species that may be listed. Similarly, the EPA also disagrees with the commenter that effects of beekeepers treating bees with tetracycline, an antibiotic, are appropriately considered ecological effects of PM pertinent to the secondary PM standard. The comment points to evidence of tetracycline occurring in airborne PM near cattle feed yards (McEachran et al., 2015) but provides no information on whether PM can be expected to have adverse effects on honeybees (and at what PM levels such effects might occur). The study does not describe effects of antibiotics on wildlife when transmitted in air, let alone indicate exposure levels at which ecological effects occur (or the likelihood of those exposure levels occurring in ambient air in different locations across the country). Accordingly, the EPA does not find this study informative to conclusions regarding the effects of PM on ecosystems (much less to consideration of an appropriate PM standard). Lastly, with regard to the commenter's reference to Recovery Plans (which are not themselves peer reviewed scientific studies and in many cases cite unpublished studies),⁸ the EPA notes that, consistent with EPA's longstanding interpretation of the requirements of CAA 109, all of the studies in the ISA, which form the scientific basis for decisions on the NAAQS, have undergone scientific peer review and been published (or at least accepted for publication), and the ISA itself has been subject to review by CASAC and the public (ISA, sections IS.1.1 and IS.1.2; U.S. EPA, 2015).

- (2) Comment: One commenter stated that the EPA should explain, in its economic analysis under Executive Orders 12866 and 14094, whether the proposed standard (or alternatives) would provide a benefit by protecting against future risks, such as the risk of changing SO₂ emissions patterns, including future increases in annual SO₂ concentrations.

Response: As an initial matter, the EPA disagrees with the commenter that an economic analysis is needed for this action. Air quality analyses described in a technical memo to the docket indicate that no change to air quality (beyond that to meet the existing primary standard) would be needed to meet the revised annual secondary SO₂ standard. Thus, the analysis concluded that no additional emissions reductions (beyond any needed to meet the current primary 1-hour SO₂ standard) would be expected to be necessary to meet the revised secondary annual SO₂ standard of 10 ppb, resulting in no costs or monetized benefits associated with pollution controls for this NAAQS revision.

⁸ The various Recovery Plans, which are not part of the criteria for this review and are generally beyond the scope of the review, variously state broad general concerns about acidity or, in a few cases, state that no data suggest such a threat and, in small number of cases, cite a study on a related species. In cases where the study cited is on the species identified, it is an unpublished document or a personal communication.

However, we agree with the commenter that the action does have the nonmonetary benefit of protecting against future increases in annual SO₂ concentrations. As discussed in section II.B.2a(3)(b) of the Preamble to the Final Action, the fact that the existing primary SO₂ standard is expected, based on recent data, to control air quality such that the new annual secondary SO₂ standard may also be met does not *a priori* make the secondary standard without benefit. The benefit is assurance of the protection of the public welfare that is required of the secondary standard separate from the protection of the public health that is required of the primary standard.

- (3) Comment: One commenter stated that EPA should set secondary standards that prevent adverse and disproportionate public welfare impacts on environmental justice (EJ) communities, including potential impacts to drinking water quality, subsistence fishing and recreational opportunities. In so doing, the commenter recommends that the EPA qualitatively consider how EJ communities could be impacted by the proposed rule and consider whether the existing standards are sufficient to avoid adverse public welfare impacts on EJ communities. In so doing, the commenter suggests the EPA use various tools, including the EPA's Environmental Justice Screening and Mapping Tool (EJScreen) to identify potentially affected areas. With regard to potential adverse impacts on EJ communities, the commenter specifically recommends the EPA consider potential impacts on recreational and subsistence fishing and impacts from interactions between N oxides and NH₃ emissions near concentrated animal feeding operations (CAFOs). With regard to CAFOs, the commenter described concerns and effects related to ammonia (NH₃) emissions, such as runoff into open-air lagoons or nearby streams which may contribute to algal blooms, foul odors and large insect populations, and concern for potential groundwater and drinking water contamination, reduction in property values and reduced quality of life. The commenter additionally stated that the EPA should consider interactions between N oxides and NH₃ that might adversely affect EJ communities and also consider the potential for N oxides emissions to "compound" any existing harmful environmental conditions in ecosystems already affected by NH₃ emissions and so create "adverse" welfare effects for some communities. Another commenter states that the EPA "must consider" EJ implications when setting secondary standards, variously referencing studies of associations of PM, SO_x and N oxides concentrations with a number of health effects, including asthma, heart attacks and strokes.

Response: The EPA notes that, as discussed in section II.C.2 of the proposal and II.A.3.b of the Final Rule, adverse impacts on recreational and subsistence fishing have public welfare implications, and we recognize, as stated in section VI.J of the proposal, the acidification risks associated with atmospheric deposition of 20 or more years ago have the potential for disproportionate and adverse impacts. In reaching his decision on the standards that would provide the requisite protection from known or anticipated adverse effects to the public welfare, the Administrator considered the public welfare significance of effects associated with ecosystem acidification, including impacts on subsistence and recreational fishing communities. In so doing he recognized that the current deposition conditions do not pose risk of adverse effects to the public welfare. Further, the new annual SO₂ standard is intended to provide continued protection from such effects. Consequently, the EPA concludes that current conditions and those associated with the revised standard are not anticipated to pose adverse risks (much less adverse and disproportionate risks) to the public welfare.

We additionally note that health effects, such as those referenced by the commenter, including among other conditions asthma, heart attacks and strokes, are outside the scope of this review. These effects are considered in reviews of the primary (health-based) NAAQS for these pollutants.

With regard to the commenter's suggestions for EPA to consider the use of various tools, such as EJScreen, we note that while such tools are frequently used to assess various environment-related stressors on different communities, they are not conducive to assessing the risk of atmospheric deposition to the public welfare. The commenter also suggests that to the extent the EPA is in need of data to assess distributional effects, it might consider sufficiency of the existing air monitoring network and the need for future expansions. The EPA has considered the adequacy of the monitoring network as part of this review (as summarized in section IV of the Preamble to the Final Rule) and concluded that additional monitors are not warranted at this time.

We recognize that analyses that characterize differences in exposure or in ambient air concentrations among populations in different areas can be informative to EPA policy in various regulatory decisions. With regard to decisions under the Clean Air Act on the NAAQS, however, such variations or differences are not directly relevant. Rather, under section 109(b)(2) of the Act, a secondary standard must "specify a level of air quality the attainment and maintenance of which, in the judgment of the Administrator, based on such criteria, is requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of [the] pollutant in the ambient air." In decision-making for the secondary standards, the EPA has not identified a need for data to consider variation among human populations in pollutant exposures.

With regard to concerns for populations near concentrated animal feeding operations, and effects related to ammonia (NH₃) emissions, the EPA notes, that ammonia is not a criteria pollutant and accordingly is outside the scope of decisions in this NAAQS review. Further, the EPA notes that in suggesting a potential for N oxides to contribute to adverse welfare effects, the commenter explicitly characterizes the potential as "hypothetical,"⁹ and provides no evidence of adverse welfare effects of N oxides in relation to CAFOs, and the EPA knows of no such evidence.

- (4) Comment: One comment stated that EPA should view the secondary NAAQS for N oxides, SO_x and PM as a critical tool to address atmospheric deposition of N in the Chesapeake Bay watershed, more specifically expressing a view that development of a secondary standard for nutrient enrichment in aquatic systems is an opportunity to achieve pollution reductions necessary to restore Chesapeake Bay and other estuarine/coastal systems. In conveying this position, this comment also references comments from the CASAC, which describe recent reductions in atmospheric N deposition to several estuaries in the context of efforts to meet total maximum daily loads set for those systems, and which the comment interprets as

⁹ As stated by the commenter if NH₃ emissions are rising, "the overall N deposition levels in certain EJ communities, like those downstream of concentrated animal feeding operations (CAFOs), could hypothetically *{emphasis added}* increase to such a degree that any additional effects from NO_x deposition may have a particular adverse impact."

encouraging there to be more such reductions and references some modeling studies that describe reductions in NO_x emissions and associated reduction in N deposition that have occurred or are projected for these systems. The comment also notes the increasing role of ammonia emissions in total N from atmospheric deposition that enters the Bay.

Response: For the reasons discussed in section II.B.3 of the Preamble to the Final Rule, the EPA disagrees that at this time the secondary NAAQS for these pollutants are an effective or appropriate tool for achieving further reductions of total N deposition, including in the Chesapeake Bay or other estuaries. We recognize that as part of the total maximum daily load (TMDL) for the Chesapeake Bay, the allocation to or cap on atmospheric sources of total N direct to Chesapeake Bay and tidal tributary surface waters is 15.7 million pounds per year (out of a total allocation of over 200 million pounds per year). As described in section II.A.3.c(1) of the Preamble to the Final Rule, the allocation of loading to different source types (e.g., ground water, surface water, atmospheric deposition) varies for both practical and policy reasons. The Chesapeake Bay TMDL loading allocation for atmospheric sources was projected to be achieved by 2020 based on air quality programs under Clean Air Act regulations and programs existing at the time of the TMDL (2010). We note that the secondary NAAQS for N oxides and PM were in place in 2010 and the comment provides no information to suggest that the existing secondary NAAQS are inconsistent with this limit. The EPA further notes that the CAA air quality programs identified as instrumental in achieving the atmospheric loading cap include rules that aim to reduce air pollution emissions in one state from impacting the air quality in another, such as the Clean Air Interstate Rule and an array of mobile source emissions regulations (https://www.epa.gov/sites/default/files/2015-06/documents/cb_airwater_fact_sheet_jan2015.pdf).

- (5) Comment: One commenter expressed the view that the EPA has failed to either follow, or explain its deviation from, recommendations provided by the CASAC in its review of the draft PA. In expressing this view the commenter listed several CASAC recommendations and CASAC critiques regarding the draft PA evaluations and conclusions. The commenter then listed the items related to recommendations in the CASAC letter on the draft PA, specifically identifying the CASAC recommendation for development of a second draft PA.

The commenter additionally stated that by failing to consider studies published after 2017, the EPA omitted data and findings that provided support for the CASAC recommended standards. Further, the commenter states that by not providing the CASAC a second draft, the EPA did not provide CASAC the opportunity to comment on the revised draft, nor did EPA explain why they did not provide such a draft.

Response: The EPA generally agrees with the importance of giving recommendations from CASAC careful consideration. However, the Administrator is never bound by the CASAC conclusions but rather may depart from them when he has reached a different judgment and provided an explanation of the reasons for such differences¹⁰, as in this case. The Administrator's consideration of the advice from the majority and minority of CASAC,

¹⁰ *Mississippi v. EPA*, 744 F.3d 1334, 1354 (DC Cir. 2013) - "Although EPA is not bound by CASAC's recommendations, it must fully explain its reasons for any departure from them."

including the rationales provided by these members, is described in section II.B.3 of the Preamble for the Final Rule.

With regard to the CASAC recommendation for development of a second draft PA for its review, the EPA notes that the Act provides for CASAC review of the air quality criteria and the standards but does not impose procedural requirements on the Agency in how to assist CASAC in its review. The process the EPA follows in each NAAQS review includes the development of a PA by the Office of Air Quality Planning and Standards (OAQPS). Review of one or more drafts of the PA by the CASAC has traditionally facilitated the CASAC development of advice to the Administrator on the NAAQS. In the circumstances where the CASAC requests an additional draft for their review, the Agency generally accommodates. However, in circumstances where the timeline for a review is constrained by court order or consent decree, the Agency cannot always accommodate additional drafts. In this review, which is governed by consent decree, while the EPA was successful in negotiating some additional time in order to address the many comments and recommendations made by the CASAC in its review of the draft PA, the applicable legally-binding deadline for the notice of proposed rulemaking was not extended enough to allow for preparation and review of a second draft document. And as noted above, the Act does not impose any requirement for preparation of a policy assessment, much less review by CASAC of multiple drafts.

With regard to the comments and recommendations by the CASAC on the draft PA cited by the commenter, although the EPA did not develop a second draft PA, the EPA carefully considered the CASAC comments and recommendations and addressed them in completion of the final PA. Some of the key areas of the PA affected by the associated revisions to assessments and evaluations are summarized in section 1.4 of the final PA. The trajectory-based analysis and associated EAQMs is one such key area, and in consideration of the CASAC comments and recommendations on the trajectory-based analysis (and associated EAQMs), the final PA incorporated an array of improvements to this analysis from what was presented in the draft PA. These improvements include: additional sensitivity analyses (e.g. stress test the selection of the sites of influence), longer trajectories (i.e., 48 hours versus 120 hours), and a more detailed methodology and reasons for methodology in the text itself. Thus, the CASAC comments on the trajectory-based analysis (and associated EAQMs) have been addressed in the final PA.

With regard to the CASAC recommendations on analyses/evaluation other than the trajectory-based analyses that were raised by the commenter, the EPA notes that these CASAC comments and all CASAC comments on the draft PA were considered in development of the final PA. As mentioned above, section 1.4 of the final PA summarizes a number of key areas which the final PA has expanded upon and improved over their treatment in the draft PA. The PA list of the ways the final PA differs from the draft PA in these key areas is included here:

- An expanded overview of the acid deposition process and chemical complexity of sulfur and nitrogen oxides;
- More specific source characterization of NH₃
- An elevated discussion of N enrichment effects, and more detailed discussion of evidence for effects in estuarine and coastal waters;

- The discussion of quantitative information pertaining to N enrichment effects in aquatic systems, particularly for estuarine and coastal areas was expanded;
- Clarification and revisions to the aquatic acidification REA and accompanying detailed appendix;
- Substantial expansions of the methodology and discussion of the trajectory analysis and uncertainty characterization of the full array of air quality analyses; and
- A new discussion of co-occurring trends in emissions, ambient air concentrations, and estimated deposition.

Regarding other CASAC comments on the draft PA that were listed by the commenter as pertaining to particular analyses or evaluations, we note that the final PA addressed these comments, as summarized below:

- CASAC comment: “Potential NH₃ emissions during fires need to be estimated.”
The final PA included estimates of NH₃ emissions from wildfires (PA Chapter 2, section 2.2.3 and Figure 2-8. Further, as suggested by the CASAC, more specific source categorization of NH₃ is also presented in Chapter 2 of the PA.
- CASAC comment: “...the PA should be revised to include a quantitative evaluation of the N deposition levels that are protective of estuaries.”
The final PA includes an expanded discussion of quantitative information for N enrichment effects in aquatic systems, particularly in estuaries (PA Chapter 5, section 5.2). For example, PA Chapter 5, section 5.2.3 was expanded, and now includes a detailed discussion of Total Maximum Daily Loads (TMDLs), with a focus on contributions of atmospheric N deposition from case-study estuaries described by the CASAC in their letter to the Administrator (Sheppard, 2023).
- CASAC comment: “Chapter 5 needs to be revised to clearly state which levels of N deposition, S deposition, NO₂, SO₂, and PM are recommended for protection.”
The final PA includes staff conclusions target levels of N and S deposition, and on options for the N oxides, SO_x and PM standards appropriate for the Administrator to consider (PA, Chapter 7). The EPA notes that Chapter 7 (“Review of the Standards”), rather than Chapter 5, is the relevant PA chapter for such recommendations and conclusions.
- CASAC comment: “In the PA, the EPA gives too little consideration to the effects on coastal systems, where N causes widespread damage.”
The final PA includes an expanded discussion of N enrichment effects, particularly in estuarine and coastal waters (PA section 4.3 has been expanded), including through the addition of a new section (section 4.3.1.2.2.) focused on N enrichment effects in estuarine and coastal ecosystems.

The commentor also stated that EPA did not describe its consideration of a list of topics they characterize as analysis gaps identified by CASAC. The final PA addressed these CASAC comments, as summarized below:

- CASAC comment: “The CASAC suggests that the EPA consider using a more systematic and perhaps quantitative approach to assess uncertainty in the data and analyses used in support of the standard setting process.” Additionally, CASAC commented that a revised PA should clarify how uncertainty is considered.

The final PA includes detailed uncertainty analyses on the air quality and aquatic acidification analyses (PA, section 5.1.4, Table 5A-53, section 6.3.1 and Table 6-13). The uncertainty analysis is consistent with similar analyses performed for NAAQS health risk analyses and is based on WHO guidance for characterizing and communicating uncertainty (WHO, 2008).

- CASAC comment: “Further rationale for the current secondary PM standard, [and] why PM was added to this review of ecological effects.”

The final PA includes additional clarification on the basis for the existing secondary PM standards and on the inclusion of PM in this review (PA, sections 1.4 and 1.3.5).

- CASAC comment: “The criteria used by the EPA to select a subset of the causal determinations from the ISA for additional risk analysis in PA Chapter 5 are unclear.”

The final PA includes additional discussion on the categories of ecological effects for which quantitative risk analyses were performed and those for which previously available information was used (PA, section 5.2.4).

- CASAC comment: “All CASAC members agree that the description of the EAQM approach and methodology lacks sufficient detail.”

The final PA includes a much expanded description of the methodology for the trajectory-based (EAQM) analyses, including detail on prior uses of the methodology (PA, section 6.2.4.1 and Appendix 6A, section 6A.2). Further three new sections were added with additional EAQM details (PA, Appendix 6A, section 6A.3 through 6A.5).

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Appendix A. List of Abbreviations and Acronyms

The following acronyms have been used for the sake of brevity in this document:

Acid neutralizing capacity	ANC
ammonia	NH ₃
ammonium	NH ₄ ⁺
Clean Air Act	CAA
Clean Air Scientific Advisory Committee	CASAC
Community Multiscale Air Quality Modeling	CMAQ
Concentrated animal feeding operations	CAFOs
Contiguous U.S.	CONUS
Ecoregion Air Quality Metric	EAQM
Environmental Justice	EJ
Environmental Protection Agency	EPA
Endangered Species Act	ESA
Integrated Review Plan	IRP
Integrated Science Assessment	ISA
kilograms per hectare per year	kg/ha-yr
Mercury	Hg
National Ambient Air Quality Standards	NAAQS
Nitric acid	HNO ₃
nitrogen	N
nitrogen dioxide	NO ₂
Nitrogen oxide	NO
Office of Air Quality Planning and Standards	OAQPS
oxides of nitrogen/nitrogen oxides	N oxides
oxides of sulfur/sulfur oxides	SO _x
particles with a nominal mean aerodynamic diameter less than or equal to 2.5 µm	PM _{2.5}
Particulate matter	PM
Parts per billion	ppb
Parts per million	ppm
Policy Assessment	PA
Prevention of Significant Deterioration	PSD
Risk and Exposure Assessment	REA
State implementation plans	SIPs
Sulfate	SO ₄ ²⁻
Sulfur	S
sulfur dioxide	SO ₂
Total Maximum Daily Loads	TMDLs

Appendix B. Clean Air Act Class I Areas in Ecoregions included in the Aquatic Acidification Risk and Exposure Assessment.

Table 1. Class 1 Areas located in the 25 ecoregions in the ecoregion-scale analyses of the aquatic acidification risk and exposure assessment.

REA* Ecoregion	REA Ecoregion Name	East(E)/ West(W)**	Number of Class 1 Areas	Class 1 Areas
5.2.1	Northern Lakes and Forests	E	6	Boundary Waters Canoe Area Wilderness Forest County Potawatomi Isle Royale NP Rainbow Lake Wilderness Seney Wilderness Voyageurs NP
5.3.1	Northeastern Highlands	E	3	Great Gulf Wilderness Lye Brook Wilderness Presidential Range-Dry River Wilderness
5.3.3		E	0	
6.2.3	Northern Rockies	W	3	Cabinet Mountains Wilderness Kalispel Spokane Reservation
6.2.5	North Cascades	W	5	Alpine Lakes Wilderness Glacier Peak Wilderness North Cascades NP Olympic NP Pasayten Wilderness
6.2.7	Cascades	W	4	Diamond Peak Wilderness Mount Adams Wilderness Mount Hood Wilderness Mount Rainier NP
6.2.10	Middle Rockies	W	7	Anaconda Pintler Wilderness Fitzpatrick Wilderness Grand Teton NP Red Rock Lakes Wilderness Teton Wilderness Wind Cave National Park Yellowstone NP
6.2.12	Sierra Nevada	W	11	Ansel Adams Wilderness Caribou Wilderness Desolation Wilderness Emigrant Wilderness Hoover Wilderness John Muir Wilderness Kaiser Wilderness Lassen Volcanic NP Mokelumne Wilderness

REA* Ecoregion	REA Ecoregion Name	East(E)/ West(W)**	Number of Class 1 Areas	Class 1 Areas
				Thousand Lakes Wilderness Yosemite NP
6.2.14	Southern Rockies	W	11	Eagles Nest Wilderness Flat Tops Wilderness La Garita Wilderness Maroon Bells-Snowmass Wilderness Mount Zirkel Wilderness Pecos Wilderness Rawah Wilderness Rocky Mountain NP San Pedro Parks Wilderness Weminuche Wilderness West Elk Wilderness
6.2.15	Idaho Batholith	W	2	Sawtooth Wilderness Selway-Bitterroot Wilderness
8.1.1		E	0	
8.1.3		E	0	
8.1.4		E	0	
8.1.7		E	0	
8.1.8	Acadian Plains and Hills	E	2	Acadia NP Moosehorn Wilderness
8.3.1		E	0	
8.3.3		E	0	
8.3.4		E	0	
8.3.5		E	0	
8.3.7		E	0	
8.4.1	Ridge and Valley	E	1	Shenandoah NP
8.4.2	Central Appalachians	E	2	Dolly Sods Wilderness Otter Creek Wilderness
8.4.4	Blue Ridge	E	6	Cohutta Wilderness Great Smoky Mountains NP James River Face Wilderness Joyce Kilmer-Slickrock Wilderness Linville Gorge Wilderness Shining Rock Wilderness
8.4.5	Ozark Highlands	E	1	Hercules-Glades Wilderness
8.4.9	Southwestern Appalachians	E	1	Sipsey Wilderness
Total			65	

* Risk and exposure assessment (PA, Appendix 5A and section 5.1)

** An ecoregion is designated western if it intersects or overlaps with any of the following 10 States: ND, SD, CO, WY, MT, AZ, NM, UT, ID, CA, OR, and WA. Eastern ecoregions are those not designated as western (PA, section 5.1.3.1).

Table 2. Class 1 areas in the eastern and western ecoregions in the ecoregion-scale analyses of the risk and exposure assessment.

Number of Class 1 Areas in Eastern* Ecoregions	Number of Class 1 Areas in Western* Ecoregions
22	43
<p>* In the ecoregion-scale analyses of the risk and exposure assessment, an ecoregion is designated western if it intersects or overlaps with any of the following 10 States: ND, SD, CO, WY, MT, AZ, NM, UT, ID, CA, OR, and WA. Eastern ecoregions are those not designated as western (PA, section 5.1.3.1). This table focuses on the 25 ecoregions in the ecoregion-scale analyses (PA, section 5.1.3.2).</p>	