STATE OF NEW MEXICO
ENVIRONMENTAL IMPROVEMENT BOARD

IN THE MATTER OF PROPOSED NEW REGULATION,
20.2.50 NMAC – *Oil and Gas Sector – Ozone Precursor Pollutants* **No. EIB 21-27 (R)**

DIRECT TESTIMONY OF MICHAEL BACA

My name is Michael Baca, and I am the Control Strategies Manager for the Air Quality Bureau ("Bureau") of the New Mexico Environment Department ("NMED" or "Department"). I am presenting this written testimony on behalf of the Department in this proceeding on proposed new air quality regulations at 20.2.50 NMAC ("Part 50"). My testimony will address the following topics: the federal and state statutory authorities and regulatory frameworks for ozone, NMED's Ozone Attainment Initiative, and the EPA Ozone Advance program.

I. QUALIFICATIONS

I have been an employee of the Department for 16 years, 13 of which have been with the Bureau. In my current position as the staff manager for the Bureau's Control Strategies Unit, I oversee a staff of six that are responsible for the development of air quality plans and regulations, including the State Implementation Plan ("SIP") for New Mexico. I hold a B.A. degree in Chemistry from Carleton College.

My full background and qualifications are set forth in my resume, which is marked as NMED Exhibit 2.

II. THE CLEAN AIR ACT REGULATORY FRAMEWORK FOR OZONE

The federal Clean Air Act ("CAA") requires the U.S. Environmental Protection Agency ("EPA") to set National Ambient Air Quality Standards ("NAAQS") for pollutants that EPA determines are harmful to public health and the environment. *See* 42 U.S.C. § 7408. These standards are in the form of maximum allowable concentrations in the ambient air during a specified time period and are designed to protect the most sensitive individuals from harm from airborne pollutants. The CAA identifies two sets of NAAQS to accomplish this: Primary standards provide public health protection, including protecting the health of vulnerable populations such as asthmatics, children, and the elderly; Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. *Id* at § 7408(b).

The EPA has set NAAQS for six principal pollutants, known as "criteria" air pollutants: ozone, nitrogen dioxide, sulfur dioxide, carbon monoxide, particulate matter 10 microns or less, particulate matter 2.5 microns or less, and lead. *See* 40 C.F.R. Part 50. The CAA requires EPA to review the standards on a periodic basis, which may result in the standards being revised based on health and environmental criteria that apply to the concentration of a pollutant in outdoor air to limit harmful exposures and detrimental effects. 42 U.S.C. § 7409(d). The primary ozone NAAQS are set to protect people most at risk from breathing ozone in the ambient air, including asthmatics, children, older adults and people who are active outdoors, such as workers. Children are at greatest risk from ozone exposure because their lungs are still developing and they are more likely to be active outdoors when ozone levels are high, which increases their exposure. Some of the health problems caused by ozone include coughing, sore throat, difficulty breathing, inflammation and damage to airways, increased frequency of asthma attacks, and aggravation of lung diseases such as asthma, emphysema and chronic bronchitis. *See* NMED Exhibit 3 – EPA Integrated Science Assessment ("ISA") for Ozone and Related Photochemical Oxidants, Executive Summary (April 2020);[1] *see also* 85 Fed. Reg. 87256, 87268-87275.

[1] Full ISA available at https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=348522

Air quality management agencies use data from monitors to calculate a "design value" to determine an area's compliance status with the NAAQS. The design value represents the metric used to compare monitoring data to the level specified by the standard. Ozone monitoring and the federal requirements for monitoring equipment are addressed in the testimony of NMED witness Brent Ellington. Calculation of design values, quality assurance of data, and submission of data to EPA are addressed in the testimony of NMED witness Andrew Ahr.

Following promulgation of a new or revised NAAQS, EPA undertakes a process of designating all areas within each state as in attainment, nonattainment, or unclassifiable for the standard. *See* 42 U.S.C. § 7407(d). This process entails collaborating with states and tribes and considering their recommendations, including proposed nonattainment boundaries based on data and information from air quality monitors or modeling. If the concentrations of a criteria pollutant in a geographic area meets or fall below the NAAQS, the area is designated as in "attainment" of the standard. Areas that exceed the NAAQS are designated as "nonattainment" areas. Areas that do not have monitoring data available are designated as "attainment/unclassifiable" or "unclassifiable". EPA is required to designate areas of the States within two years of promulgating a new or revised NAAQS. *Id.*

In October 2015, following a periodic review, EPA revised the ozone NAAQS downward from 0.075 parts per million (ppm) to 0.070 ppm. *See* 80 Fed. Reg. 65291. For the 2015 ozone NAAQS, all states were required to submit their designation recommendations to EPA by October 1, 2016. Ozone data collected by NMED from 2014 through 2016 showed that a monitor located in the Sunland Park area in southern New Mexico was violating the revised ozone standard. NMED submitted a nonattainment area recommendation for the Sunland Park area and recommended attainment or attainment/unclassifiable designations for the remainder of

New Mexico. EPA concurred with the recommendations and finalized the area designations for New Mexico on August 3, 2018. *See* 83 Fed. Reg. 25776.

On December 23, 2020, EPA retained the existing 2015 ozone NAAQS. *See* 85 Fed. Reg. 87256. The CAA does not require EPA to promulgate area designations when an existing NAAQS is retained following the periodic review process. In line with this and historical practice, EPA did not designate new nonattainment areas following this periodic NAAQS review. However, the current EPA administration has indicated that it intends to revisit the review process, including the available scientific evidence and exposure/risk information, to assess the adequacy of public health and welfare protection provided under the current NAAQS.

Ozone monitoring data for 2018-2020 indicate that other areas of the state are approaching or violating the 2015 ozone NAAQS. In particular, Eddy County and sites in southern Doña Ana County are monitoring ozone levels in violation of the NAAQS, while San Juan, Lea, Santa Fe, Sandoval and Valencia Counties are within 95% of the standard. Additionally, oil and gas sources located in Rio Arriba and Chaves Counties contribute to elevated ozone concentrations in the San Juan and Permian Basins, respectively.

The New Mexico Air Quality Control Act ("AQCA"), NMSA 1978, Sections 74-2-1 to -17, requires the State to plan for ozone mitigation in areas where sources cause or contribute to ozone levels greater than or equal to 95% of the ozone standard. NMED is addressing these areas through the Ozone Attainment Initiative and EPA's Ozone Advance program, as discussed below.

III. OZONE REGULATION UNDER THE NEW MEXICO AIR QUALITY CONTROL ACT AND REGULATIONS

The Environmental Improvement Board ("Board") is authorized to adopt Part 50 pursuant to the AQCA. Section 74-2-5(A) of the AQCA provides that the Board "shall prevent or abate air pollution." Section 74-2-5(B)(1) states that the Board shall "adopt, promulgate, publish, amend, and repeal rules and standards consistent with the Air Quality Control Act to attain and maintain national ambient air quality standards and prevent or abate air pollution . . ." The AQCA defines "air pollution" as

> the emission, except emission that occurs in nature, into the outdoor atmosphere of one or more air contaminants in quantities and of a duration that may with reasonable probability injure human health or animal or plant life or as may unreasonably interfere with the public welfare, visibility or the reasonable use of property.

NMSA 1978, § 74-2-2(B). "Air contaminant" is defined as "a substance, including any particulate matter, fly ash, dust, fumes, gas, mist, smoke, vapor, micro-organisms, radioactive material, any combination thereof or any decay or reaction product thereof." NMSA 1978, § 74-2-2(A).

The AQCA also contains provisions that specifically authorize the Board to adopt regulations to ensure attainment and maintenance of the ozone NAAQS. Section 74-2-5(C) of the AQCA mandates that the Board take action to control VOC and NOx emissions when the Board determines that emissions from sources within its jurisdiction cause or contribute to ozone concentrations in excess of ninety-five percent of the ozone NAAQS. Under this statutory provision, the Board is required to "adopt a plan, including rules, to control emissions of oxides of nitrogen, or NO_X, and volatile organic compounds, or VOCs, to provide for the attainment and maintenance of the standard."

IV. THE DEPARTMENT'S OZONE ATTAINMENT INITIATIVE

Currently, nine counties under the Board's jurisdiction are registering or contributing to ozone design values exceeding 95% of the NAAQS: San Juan, Rio Arriba, Santa Fe, Sandoval, Valencia, Eddy, Lea, Chaves and Doña Ana.

To address the statutory requirement in Section 74-2-5(C) of the AQCA, the Bureau has embarked upon the Ozone Attainment Initiative ("OAI") to develop a plan that consists of a series of mandatory rules and voluntary measures to mitigate emissions of NO_X and VOCs in the aforementioned counties. This rulemaking is the first of the mandatory rules being brought before the Board under the OAI. The Department intends to propose addition rules targeting other sectors. For instance, Section 177 of the Clean Air Act allows other states to adopt California's motor vehicle emission standards, and the Department intends to bring before the Board regulations setting standards for low emission vehicles ("LEV"), and zero emission vehicles ("ZEV") for adoption in 2022 that will provide further mitigation of ozone precursors.

The Department has also submitted a letter of participation to EPA for the Ozone Advance Program. The Advance Program is a means to promote local actions in areas designated as in attainment to reduce ozone levels for the continued maintenance of the NAAQS. The Bureau will coordinate efforts with local governments, industry, academia, and the public to take proactive steps towards the protection of air quality. In addition to positioning areas to avoid a nonattainment designation, the Advance Program can allow communities to choose control measures that are cost effective and that make the most sense for their area, potentially resulting in multi-pollutant benefits.

The Department has developed a path forward for Ozone Advance that outlines all the activities, programs, and control measures to be included as part of our program. A copy of the "Ozone Advance Path Forward for New Mexico" is included as NMED Exhibit 4. The Department requests that the Board adopt this document as the "Plan" required by Section 74-5-3(C) of the AQCA.

Because the ozone design value in Bernalillo County also exceeds 95% of the ozone NAAQS, the Bureau is coordinating its efforts for ozone mitigation with the City of Albuquerque's Environmental Health Department, which has jurisdiction over air quality in Bernalillo County. In addition to the OAI, Ozone Advance and vehicle emissions standards, the Department is also working with the City of Albuquerque on preparing revised Regional Haze SIPs for submittal to EPA in July of 2021. The goal of the Regional Haze provisions of the CAA is to improve visibility in protected national parks and wilderness areas (referred to as "Class I" areas), and states are required to make reasonable progress over time towards the long-term goal of attaining natural visibility conditions by 2064. The Regional Haze program requires states to submit Regional Haze SIPs approximately once every ten years. Based on data collected at monitors operated by federal land managers, visibility impairment at the Class I areas in New Mexico is driven by sulfates and nitrates, so the Department is evaluating potential additional controls for sulfur dioxide (SO_2) and NO_X emissions from twenty-three major sources within our jurisdiction. Three of these sources are electric generating units, and the remainder are in the oil and gas sector, specifically, natural gas compressor stations and processing plants. Any additional NO_X controls for these sources adopted as part of this Regional Haze SIP revision will also serve to reduce the formation of ozone.

MICHAEL G. BACA

EDUCATION

September 1999-June 2004 | Carleton College | Northfield, MN
Bachelors Degree in Chemistry

PROFESSIONAL EXPERIENCE

January 2019-Present
New Mexico Environment Department, Air Quality Bureau
Staff Manager

- Manage the Control Strategies Section to insure proper implementation of the federal Clean Air Act in New Mexico through the development and revision of the State Implementation Plan and other air quality management plans and rules for the state.
- Oversee, lead and assist with rulemaking and section projects including the preparation of testimony and exhibits to present before the Environmental Improvement Board for adoption of rules and management plans.
- Manage air quality programs and research projects to ensure proper procurement procedures, awarding of contracts and grants, timely submission of deliverables and appropriate financial expenditures to meet contractual obligations and compliance with state rules.
- Ensure that the Bureau's Performance Measures are achieved through high technical and professional standards while maintaining the section as a desirable place to work.
- Assign, prioritize and oversee completion of tasks and projects by reviewing work products and providing timely, substantive feedback including guidance to staff on programs, policies, rules, regulations, and resources.
- Conduct meaningful and constructive employee evaluations by providing appropriate recognition of strengths, weaknesses and recommendations for improvement.
- Fill vacancies by completing efficient and effective personnel hiring actions.

July 2008-December 2018
New Mexico Environment Department, Air Quality Bureau
Environmental Analyst-Advanced

- Represent the State of New Mexico as the air quality liaison with border air quality agencies and stakeholders, participating in the Joint Advisory Committee and the USEPA Border 2020 Program.
- Develop and prepare technical testimony and exhibits for public hearings in front of the Environmental Improvement Board to present and defend air quality plans and rules for adoption in New Mexico, including state implementation plans required by the USEPA.
- Analyze ambient air quality monitoring data and prepare technical support documents for submission to the USEPA for high wind blowing dust events that cause air pollution episodes.

- Conduct public education and outreach meetings and develop educational material regarding air quality, rule requirements, and rule development.
- Review and comment on Title V and PSD permits, Environmental Impact Statements and Environmental Assessments in the border region for compliance with federal and state rules and standards.
- Manage air quality research projects and contracts in the border area to ensure timely submission of deliverables and appropriate financial expenditures.

February 2005 -July 2008
New Mexico Environment Department, Field Operations
Environmental Scientist and Specialist-Advanced

- Review engineering plans and approve permits for construction of swimming pool and bath facilities.
- Oversee district operations to ensure adequate permitting and inspection of public swimming pool facilities.
- Conduct training for swimming pool department staff and operators.
- Permit and inspect restaurants and food processors, swimming pool facilities, and liquid waste disposal system installations for compliance with applicable regulations.
- Conduct public education and outreach to help the regulated and general public comply with administrative requirements and state regulations.

EPA/600/R-20/012
April 2020
www.epa.gov/isa

Integrated Science Assessment for Ozone and Related Photochemical Oxidants

April 2020

Center for Public Health and Environmental Assessment
Office of Research and Development
U.S. Environmental Protection Agency
Research Triangle Park, NC

EXECUTIVE SUMMARY

ES.1 Purpose and Scope of the Integrated Science Assessment

This Integrated Science Assessment (ISA)[1] is a comprehensive evaluation and synthesis of the policy-relevant science aimed at characterizing the health and welfare[2] effects caused by ozone. It communicates critical science judgments of the health-based and welfare-based criteria for ozone and related photochemical oxidants in ambient air. In 2015, the U.S. EPA lowered the health- and welfare-based National Ambient Air Quality Standards (NAAQS) for ozone to 0.070 ppm (annual fourth-highest daily max 8-hour concentration averaged over 3 years[3]). The health-based ozone NAAQS is meant to protect public health, including at-risk populations such as children and people with asthma, with an adequate margin of safety. The welfare-based ozone standard is intended to protect the public welfare from known or anticipated adverse effects associated with the presence of ozone in ambient air.

The ISA identifies and critically evaluates the most policy-relevant scientific literature across scientific disciplines, including epidemiology, controlled human exposure studies, animal toxicology, atmospheric science, exposure science, vegetation studies, agricultural science, ecology, and climate-related science. Key scientific conclusions (e.g., causality determinations; Section ES.4) are presented and explained. These conclusions provide the scientific basis for developing risk and exposure analyses, policy evaluations, and policy decisions for the review. This ISA draws conclusions about the causal nature of the relationships between ozone exposure and health and welfare effects by integrating recent evidence across scientific disciplines with the evidence base evaluated in previous reviews. U.S. EPA engages the Clean Air Scientific Advisory Committee (CASAC) as an independent federal advisory committee to conduct peer reviews of draft ISA and other materials. Peer review comments provided by the CASAC and public comments about the external review draft were considered in the development of this ISA (Section 10.4). The ISA thus provides the policy-relevant scientific information necessary to conduct a review of the NAAQS.

This Executive Summary provides an overview of the important conclusions drawn in the ISA across scientific disciplines, beginning with information on sources, concentrations, estimated background concentrations of ozone and ozone exposure, followed by health and welfare effects. A more detailed summary of the evidence is presented in the Integrated Synthesis, and individual Appendices for

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[1] The general process for developing an ISA, including the framework for evaluating weight of evidence and drawing scientific conclusions and causality determinations, is described in a companion document, Preamble to the Integrated Science Assessments (U.S. EPA, 2015), www.epa.gov/isa.

[2] Under Clean Air Act section 302(h), effects on welfare include, but are not limited to, "effects on soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility, and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being."

[3] Final rule signed October 1, 2015, and effective December 28, 2015 (80 FR 65291).

each topic area include study-level information and an in-depth characterization of the weight-of-evidence conclusions.

ES.2 Ozone in Ambient Air

The general photochemistry of tropospheric ozone is well-established. Ozone is produced in urban areas and downwind of sources mainly by the reaction of volatile organic compounds (VOCs) with oxides of nitrogen (NO_X) in the presence of sunlight, and outside of polluted areas mainly by reactions of carbon monoxide (CO) and methane (CH_4) with NO_X (Section 1.4). Recent developments in understanding ozone chemistry include observations of higher ozone concentrations during the winter in some western U.S. mountain basins (Section 1.4.1) and new research on the role of marine halogen chemistry in suppressing coastal ozone concentrations (Section 1.4.2). Air monitoring data for the period 2015−2017 show that U.S. daily max 8-hour avg concentrations of ozone (MDA8) are higher in spring and summer (median = 46 ppb) than in autumn (median = 38 ppb) and winter (median = 34 ppb). Figure ES-1 shows the highest values of the 3-year avg of annual fourth-highest MDA8 ozone concentrations (design values above 70 ppb) occur in central and southern California, Arizona, Colorado, Utah, Texas, along the shore of Lake Michigan, and in the Northeast Corridor, typically during the ozone season between May and September (Section 1.2.1.1).

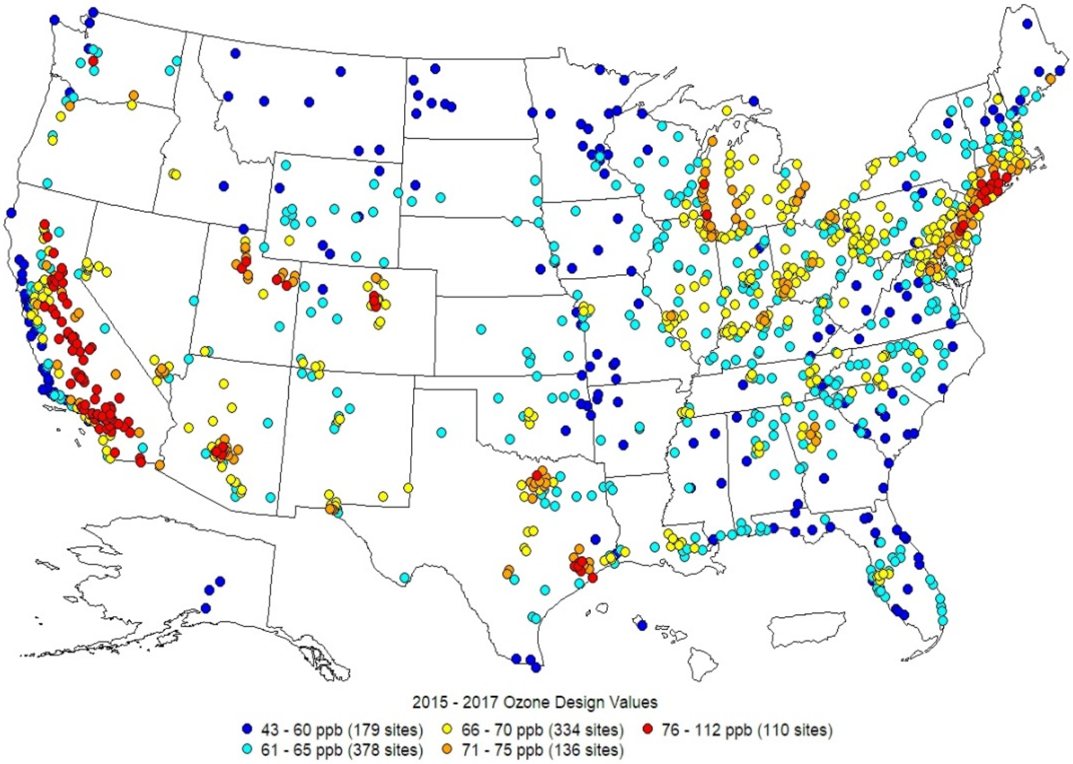


Figure ES-1 Individual monitor ozone concentrations in terms of design values (i.e., 3-year avg of annual fourth-highest max daily 8-hour avg ozone concentration) for 2015−2017.

A better understanding of the origins of ground-level U.S. background (USB) ozone and its concentration trends has emerged since the 2013 Ozone ISA. USB ozone concentration is defined as the ozone concentration that would occur if all U.S. anthropogenic ozone precursor emissions were removed (Section IS.2.2). Major contributors to USB ozone concentrations are stratospheric exchange, international transport, wildfires, lightning, global methane emissions, and natural biogenic and geogenic precursor emissions. Ozone monitors cannot discern the portion of ambient ozone concentrations that come from USB. Instead, USB concentrations are estimated using photochemistry and transport models. The estimates of USB ozone concentrations include uncertainties of about 10 ppb for seasonal average concentrations, with higher uncertainty for MDA8 concentrations. Models consistently estimate higher USB ozone concentrations at higher elevations of the western U.S. than in the eastern U.S. or along the Pacific coast. The estimated seasonal pattern in USB ozone concentrations tends to indicate lower USB in the summer than during the rest of the year. Several modeling studies using different approaches indicate that for MDA8 concentrations above 50−60 ppb, USB concentration estimates generally do not increase with increasing total ozone concentration (i.e., USB ozone concentrations are no higher on high ozone days than on low or moderate ozone days). The temporal trend in estimated USB ozone concentrations indicates increasing concentrations at high elevation western U.S. sites through approximately 2010.

Recently, however, this trend has shown signs of slowing or even reversing, possibly due to decreasing East Asian precursor emissions.

ES.3 Exposure to Ozone

Ambient air ozone concentrations, either measured at fixed-site monitors or estimated by models, are often used as surrogates for personal exposure in epidemiologic studies. Exposure measurement error can lead to reduced precision and an underestimation of the association between short-term ambient ozone exposure and a health effect (Section 2.6.1). For studies of long-term exposure, the true effect of exposure to ambient ozone may be underestimated or overestimated when the exposure model respectively overestimates or underestimates ozone exposure. It is much more common for the effect to be underestimated, and bias in the effect estimate is typically small in magnitude (Section 2.6.2). The availability and sophistication of models to predict ambient ozone concentrations to estimate exposure have increased substantially in recent years (Section 2.3.2). For effects elicited by ozone, the use of exposure estimates that do not account for population behavior and mobility (e.g., via use of time-activity data) may result in underestimation of the true effect and reduced precision (Section 2.4.1).

Tropospheric ozone can cause plant damage, which can then have negative impacts on terrestrial ecosystems as shown in observational and controlled exposure studies and in models using experimental data to extrapolate to effects at the community and ecosystem scale. Robust exposure indices that quantify exposure as it relates to measured plant response (e.g., growth) have been in use for decades and are derived from hourly ozone concentrations. Exposure duration influences the degree of plant response, and ozone effects on plants are cumulative. Cumulative indices summarize ozone concentrations over time and provide a consistent metric for reviewing and comparing exposure-response effects obtained from various studies. Cumulative indices of exposure that differentially weight hourly concentrations have been found to be best suited to characterize vegetation exposure to ozone with regard to reductions in vegetation growth and yield (Section 8.1.2.1).

ES.4 Health and Welfare Effects of Ozone Exposure

Broad health and welfare effect categories are evaluated independently in the Appendices of this ISA. Determinations are made about causation by evaluating evidence across scientific disciplines and are based on judgments of consistency, coherence, and biological plausibility of observed effects, as well as related uncertainties. The ISA uses a formal causality framework to classify the weight of evidence using a five-level hierarchy described in Table II of the Preamble (U.S. EPA, 2015). The subsequent sections characterize the evidence that forms the basis of causality determinations for health and welfare effect categories of a "causal relationship" or a "likely to be causal relationship," or describe instances where a causality determination has changed (i.e., "likely to be causal" changed to "suggestive of, but not sufficient to infer, a causal relationship"). Other relationships between ozone and health effects are *"suggestive of, but not sufficient to infer*" and "*inadequate to infer*" a causal relationship. These causality determinations appear in Table ES-1, and are more fully discussed in the respective health effects Appendices.

ES.4.1 Health Effects of Ozone Exposure

Ozone-induced effects can occur through a variety of complex pathways within the body. After inhalation, ozone reacts with lipids, proteins, and antioxidants in the epithelial lining fluid of the respiratory tract, creating secondary oxidation products (Section 5.2.3). Initial ozone exposure leads to physiological reactions that may induce a host of autonomic, endocrine, immune, and inflammatory responses throughout the body at the cellular, tissue, and organ level. Recent evidence continues to support ozone-induced effects on the respiratory system. In addition, recent evidence indicates that short-term exposure to ozone is likely to induce metabolic effects, as shown in Figure ES-2. There is also some evidence that ozone exposure can affect the cardiovascular and nervous systems, reproduction and development, and mortality, although there are more uncertainties associated with interpretation of the evidence for these effects.

Table ES-1 Summary of causality determinations by exposure duration and health outcome.

Health Outcome[a]	Conclusions from 2013 Ozone ISA	Conclusions in the 2020 ISA
Short-term exposure to ozone		
Respiratory effects	Causal relationship	Causal relationship
Cardiovascular effects	Likely to be causal relationship	Suggestive of, but not sufficient to infer, a causal relationship[c]
Metabolic effects	No determination made	Likely to be causal relationship[b]
Total mortality	Likely to be causal relationship	Suggestive of, but not sufficient to infer, a causal relationship[c]
Central nervous system effects	Suggestive of a causal relationship[d]	Suggestive of, but not sufficient to infer, a causal relationship
Long-term exposure to ozone		
Respiratory effects	Likely to be causal relationship	Likely to be causal relationship
Cardiovascular effects	Suggestive of a causal relationship[d]	Suggestive of, but not sufficient to infer, a causal relationship
Metabolic effects	No determination made	Suggestive of, but not sufficient to infer, a causal relationship[b]
Total mortality	Suggestive of a causal relationship[d]	Suggestive of, but not sufficient to infer, a causal relationship
Reproductive effects	Suggestive of a causal relationship[d]	Effects on fertility and reproduction: suggestive of, but not sufficient to infer, a causal relationship[b]
		Effects on pregnancy and birth outcomes: suggestive of, but not sufficient to infer, a causal relationship[b]
Central nervous system effects	Suggestive of a causal relationship[d]	Suggestive of, but not sufficient to infer, a causal relationship
Cancer	Inadequate to infer a causal relationship	Inadequate to infer the presence or absence of a causal relationship[e]

[a]Health effects (e.g., respiratory effects, cardiovascular effects) include the spectrum of outcomes, from measurable subclinical effects (e.g., decrements in lung function, blood pressure) to observable effects (e.g., medication use, hospital admissions) and cause-specific mortality. Total mortality includes all-cause (nonaccidental) mortality, as well as cause-specific mortality.

[b]Denotes new causality determination.

[c]Denotes change in causality determination from 2013 Ozone ISA.

[d]Since the 2013 Ozone ISA, the causality determination language has been updated and this category is now stated as suggestive of, but not sufficient to infer, a causal relationship.

[e]Since the 2013 Ozone ISA, the causality determination language has been updated and this category is now stated as inadequate to infer the presence or absence of a causal relationship.

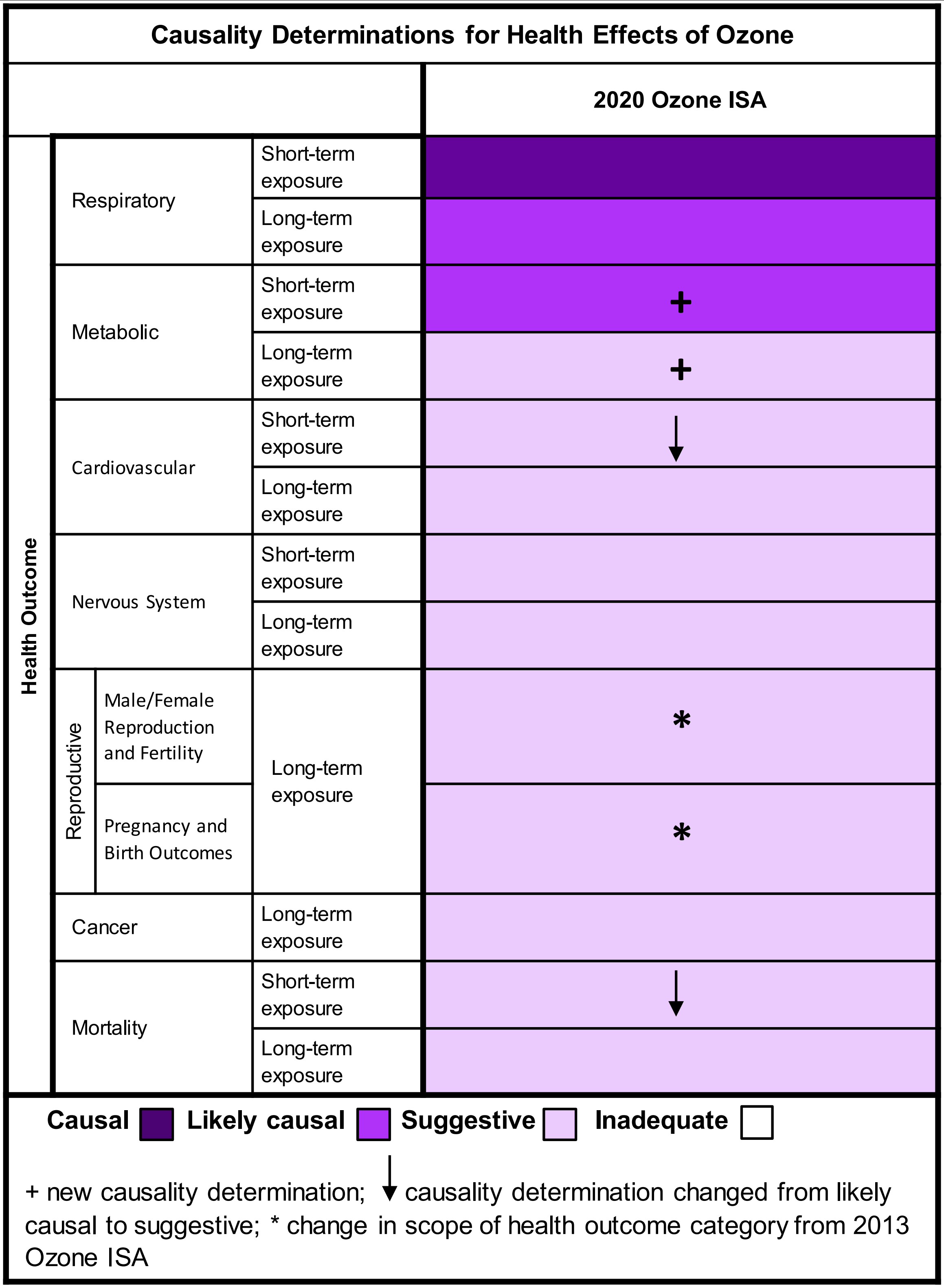


Figure ES-2 Causality determinations for health effects of short- and long-term exposure to ozone.

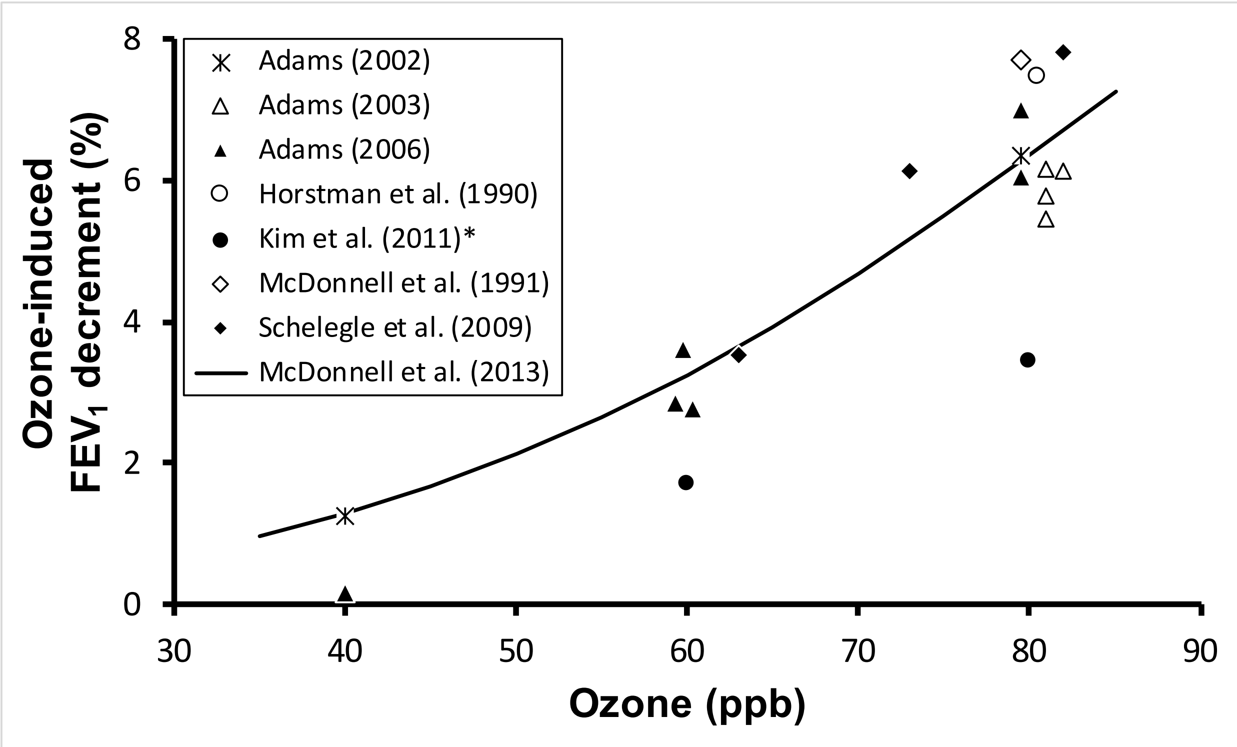
The strongest evidence for health effects due to ozone exposure continues to come from studies of short- and long-term ozone exposure and respiratory health, and this evidence is detailed in Appendix 3. Consistent with conclusions from the 2013 Ozone ISA (Table ES-1), **there is a "causal relationship" between short-term ozone exposure and respiratory effects** (Section 3.1.11), and **there is a "likely to be causal relationship" between long-term ozone exposure and respiratory effects** (Section 3.2.6).

For short-term ozone exposure, controlled human exposure studies conducted over many decades provide experimental evidence for ozone-induced lung function decrements (Figure ES-3), airway responsiveness, respiratory symptoms, and respiratory tract inflammation. Epidemiologic studies continue to provide evidence that ozone concentrations in ambient air are associated with a range of respiratory effects, including asthma exacerbation, chronic obstructive pulmonary disease (COPD) exacerbation, respiratory infection, and hospital admissions and emergency department (ED) visits for combined respiratory diseases.

A large body of animal toxicological studies demonstrate ozone-induced alterations in lung function, inflammation, increased airway responsiveness, and impaired lung host defense. These animal toxicological studies also aid in our understanding of potential mechanisms underlying respiratory effects at the population level and the biological plausibility of epidemiologic associations between short-term ozone exposure and respiratory-related ED visits and hospital admissions.

With respect to long-term ozone exposure, there is strong coherence between animal toxicological studies of changes in lung morphology and epidemiologic studies reporting positive associations between long-term ozone exposure and new-onset asthma, respiratory symptoms in children with asthma, and respiratory mortality. Furthermore, the experimental evidence provides biologically plausible pathways through which long-term ozone exposure could lead to respiratory effects reported in epidemiologic studies.

Metabolic effects related to ozone exposure are evaluated as a separate health endpoint category for the first time in this ISA (Appendix 5). Recent evidence from animal toxicological, controlled human exposure, and epidemiologic studies indicate that **there is a "likely to be causal relationship" between short-term ozone exposure and metabolic effects** (Section 5.1.8). The strongest evidence for this determination is provided by animal toxicological studies that demonstrate impaired glucose tolerance, increased serum triglycerides, fasting hyperglycemia, and increased hepatic gluconeogenesis in various stocks/strains of animals across multiple laboratories. Biological plausibility is provided by results from controlled human exposure and animal toxicological studies that demonstrate activation of sensory nerve pathways following ozone exposure triggers the central neuroendocrine stress response, which includes increased corticosterone, cortisol, and epinephrine production. These findings are coherent with epidemiologic studies that report associations between ozone exposure and perturbations in glucose and insulin homeostasis. In addition, these pathophysiological changes are often accompanied by increased inflammatory markers in peripheral tissues and by activation of the neuroendocrine system.



All responses at and above 70 ppb (targeted concentration) were statistically significant ($p < 0.05$). Adams (2006) found statistically significant responses to square-wave chamber exposures at 60 ppb based on the analysis of Brown et al. (2008) and Kim et al. (2011). During each hour of the exposures, subjects were engaged in moderate quasi-continuous exercise (20 L/minute per m^2 BSA) for 50 minutes and rest for 10 minutes. Following the 3rd hour, subjects had an additional 35-minute rest period for lunch. The data at 60 and 80 ppb have been offset on the *x* axis for illustrative purposes. The solid line illustrates the predicted FEV_1 decrements using Model 3 coefficients at 6.6 hours as a function of ozone concentration for a 23.8-year-old with a BMI of 23.1 kg/m^2 from McDonnell et al. (2013).

*80 ppb data for 30 health subjects were collected as part of the Kim et al. (2011) study, but only published in Figure 5 of McDonnell et al. (2012).

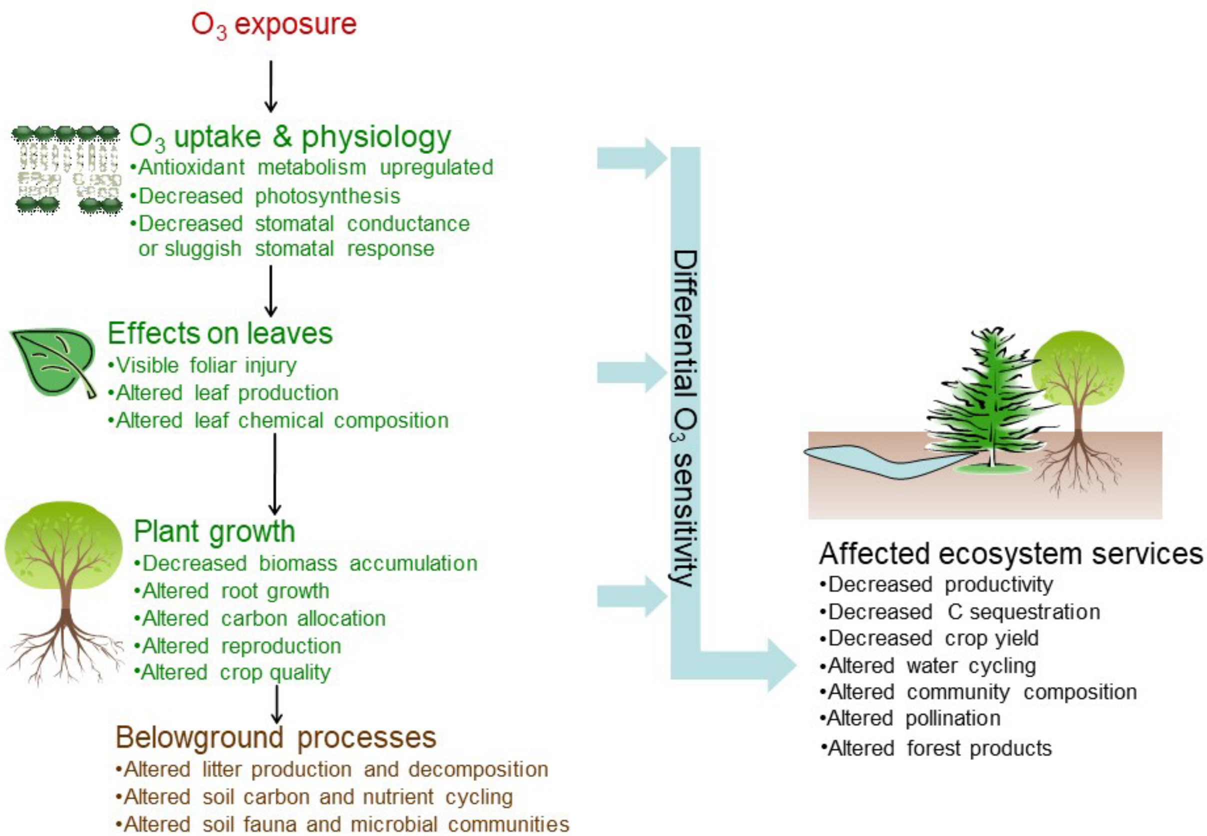
Adapted from Figure 6-1 of 2013 Ozone ISA (U.S. EPA, 2013). Studies appearing in the figure legend are: Adams (2006), Adams (2003), Adams (2002), Horstman et al. (1990), Kim et al. (2011), McDonnell et al. (2013), McDonnell et al. (1991), and Schelegle et al. (2009).

Figure ES-3 Cross-study comparisons of mean decrements in ozone-induced forced expiratory volume in 1 second (FEV_1) in young, healthy adults following 6.6 hours of exposure to ozone.

Notably, there are changes in the causality determinations for short-term ozone exposure and cardiovascular effects (Appendix 4), as well as for total mortality (Appendix 6). In both instances, the evidence synthesized in the 2013 Ozone ISA was sufficient to conclude a “likely to be causal relationship,” but after integrating the previous evidence with recent data, **the collective evidence is “suggestive of, but not sufficient to infer, a causal relationship” between short-term ozone exposure and cardiovascular effects (Section 4.1.17) or total mortality (Section 6.1.8)** in this ISA. The evidence that supports this change in the causality determinations includes: (1) a growing body of controlled human exposure studies providing less consistent evidence for an effect of short-term ozone exposure on cardiovascular health endpoints; (2) a paucity of positive evidence from epidemiologic studies for more severe cardiovascular morbidity endpoints (i.e., heart failure, ischemic heart disease and myocardial infarction, arrhythmia and cardiac arrest, and stroke); and (3) uncertainties due to a lack of control for potential confounding by copollutants in epidemiologic studies. Although there is generally consistent evidence for a limited number of ozone-induced cardiovascular endpoints in animal toxicological studies and for cardiovascular mortality in epidemiologic studies, these results are not coherent with results from controlled human exposure and epidemiologic studies examining cardiovascular morbidity endpoints. There remains evidence for ozone-induced cardiovascular mortality from epidemiologic studies. However, inconsistent results from a larger number of recent controlled human exposure studies that do not provide evidence of cardiovascular effects in response to short-term ozone exposure introduce additional uncertainties.

ES.4.2 Ozone Exposure and Welfare Effects

The scientific evidence for welfare effects of ozone consists mainly of effects on vegetation and ecosystems (Appendix 8) and effects on climate (Appendix 9). For ecological effects, damage to terrestrial ecosystems as evaluated through controlled exposure studies, observational studies and modeling based on experimental data, is largely a function of uptake of ozone into the leaf via stomata (gas exchange openings on leaves). Subsequent reactions with plant tissues alter whole-plant responses that cascade up to effects at higher levels of biological organization (i.e., from the cellular and subcellular level to the individual organism up to ecosystem level processes and services; Figure ES-4). At the leaf level, ozone uptake produces reactive oxygen species that affect cellular function (Section 8.1.3 and Figure 8-2). Reduced photosynthesis, altered carbon allocation, and impaired stomatal function lead to observable responses in plants. Observed vegetation responses to ozone include visible foliar injury (Section IS.5.1.1), and whole-plant level responses (Section IS.5.1.2), which encompass reduction in aboveground and belowground growth, reproduction and yield. Plant-fauna linkages affected by ozone include herbivores that feed on ozone-damaged vegetation and interactions of ozone with compounds emitted by plants that can alter attraction of pollinators to plants (Section IS.5.1.3). A combination of observational and experimental data, and modeling output provides evidence for broad changes in ecosystems such as decreased productivity and carbon sequestration (Section IS.5.1.4), altered belowground processes (Section IS.5.1.5), terrestrial community composition (Section IS.5.1.6), and water cycling (Section IS.5.1.7).



Source: Adapted from U.S. EPA (2013).

Figure ES-4 Illustrative diagram of ozone effects cascading from the cellular level to plants and ecosystems.

There are 12 causality determinations for ecological effects of ozone generally organized from the individual-organism scale to the ecosystem scale in Figure ES-5. Like the findings of the 2013 Ozone ISA (Table ES-2), five are causal relationships (i.e., visible foliar injury, reduced vegetation growth, reduced crop yield, reduced productivity, and altered belowground biogeochemical cycles) and two are likely to be causal relationships (i.e., reduced carbon sequestration, altered ecosystem water cycling). One of the endpoints, alteration of terrestrial community composition, is now concluded to be a causal relationship whereas in the 2013 Ozone ISA this endpoint was classified as a likely to be causal relationship. Three new endpoint categories (i.e., increased tree mortality, alteration of herbivore growth and reproduction, alteration of plant-insect signaling) not evaluated in the 2013 Ozone ISA, are all determined to have a likely to be causal relationship with ozone. Plant reproduction, previously considered as part of the evidence for growth effects, is now a stand-alone causal relationship.

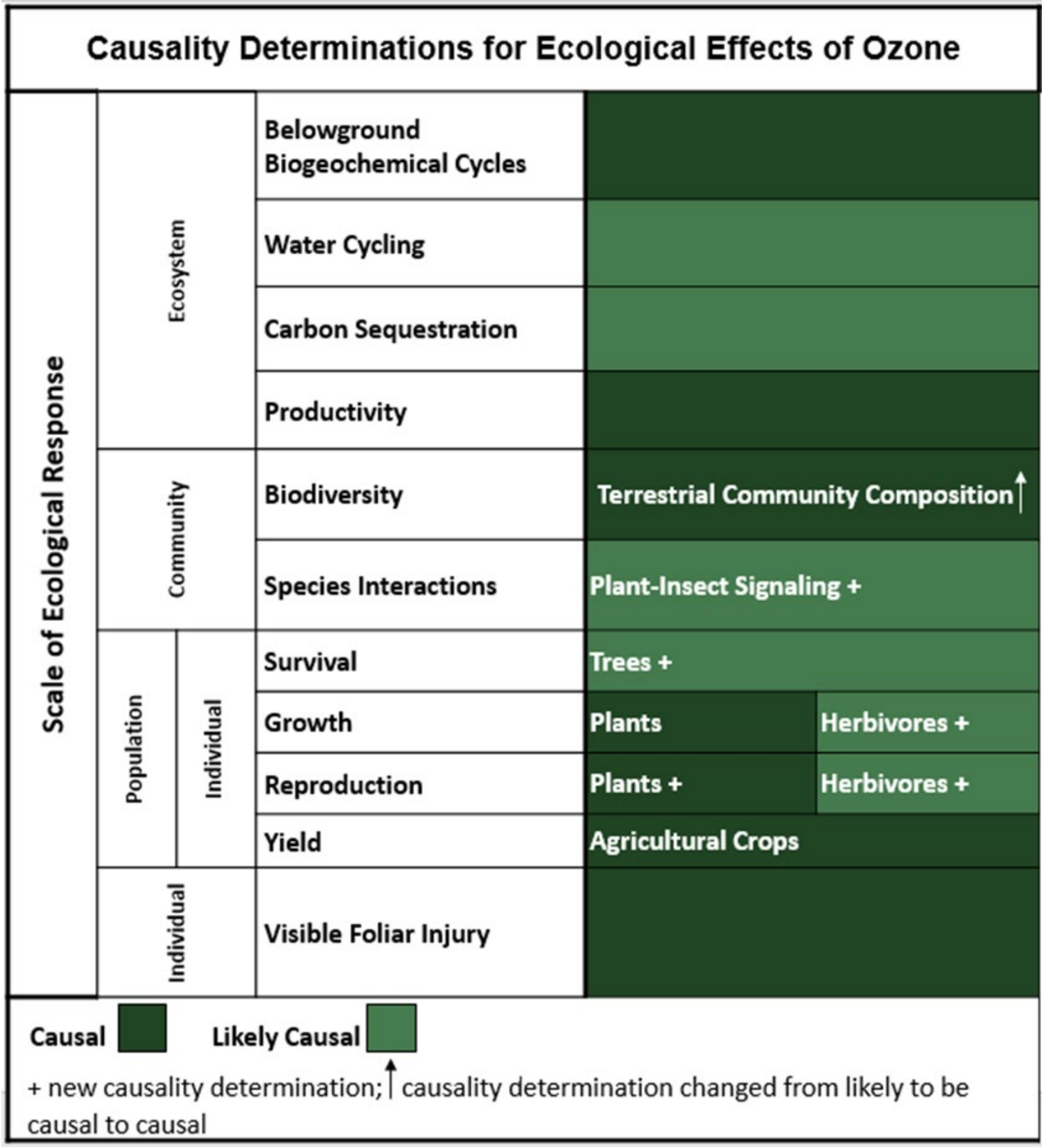


Figure ES-5 Causality determinations for ozone across biological scales of organization and taxonomic groups.

Table ES-2 Summary of causality determinations for ecological effects.

Endpoint	Conclusions from 2013 Ozone ISA	Conclusions in the 2020 ISA
Visible foliar injury	Causal relationship	Causal relationship
Reduced vegetation growth	Causal relationship	Causal relationship
Reduced plant reproduction	No separate causality determination; included with plant growth	Causal relationship[a]
Increased tree mortality	Causality not assessed	Likely to be causal relationship[a]
Reduced yield and quality of agricultural crops	Causal relationship	Causal relationship
Alteration of herbivore growth and reproduction	Causality not assessed	Likely to be causal relationship[a]
Alteration of plant-insect signaling	Causality not assessed	Likely to be causal relationship[a]
Reduced productivity in terrestrial ecosystems	Causal relationship	Causal relationship
Reduced carbon sequestration in terrestrial ecosystems	Likely to be causal relationship	Likely to be causal relationship
Alteration of belowground biogeochemical cycles	Causal relationship	Causal relationship
Alteration of terrestrial community composition	Likely to be causal relationship	Causal relationship[b]
Alteration of ecosystem water cycling	Likely to be causal relationship	Likely to be causal relationship

[a]Denotes new causality determination.
[b]Denotes change in causality determination from 2013 Ozone ISA.

Visible foliar injury resulting from exposure to ozone has been well characterized and documented in over six decades of controlled experimental research involving many tree, shrub, herbaceous, and crop species and using both long-term field studies and laboratory approaches. Recent experimental evidence (Section 8.2) continues to show a consistent association between visible injury and ozone exposure supporting the conclusion of the 2013 Ozone ISA that, **there is a "causal relationship" between ozone and visible foliar injury.** Measured changes in photosynthesis and carbon allocation in ozone-exposed plants scale up to reduced growth documented in natural and managed (e.g., agriculture, forestry, landscaping) species (Section 8.3), as well as impaired reproduction in individual plants (Section 8.4.1). Consistent with the conclusions in the 2013 Ozone ISA, there is **a "causal relationship"**

between ozone and reduced plant growth and **a "causal relationship" between ozone and reduced crop yield and quality**. In the 2013 Ozone ISA, reproduction was considered in the same category with plant growth. Increased information on metrics of plant reproduction (e.g., observed flower number, fruit number, fruit weight, seed number, rate of seed germination) and evidence for direct negative effects on reproductive tissues as well as for indirect negative effects (resulting from decreased photosynthesis and other whole-plant physiological changes) warrants a separate causality determination of **a "causal relationship" between ozone exposure and reduced plant reproduction**. Since the 2013 Ozone ISA, a large-scale multivariate analysis of factors contributing to tree mortality (1971−2005) concluded that county-level ozone concentrations averaged over the study period significantly increased tree mortality in 7 out of 10 plant functional types in the eastern and central U.S. (Section 8.4.3). This evidence, combined with observations of long-term declines of conifer forests in several high ozone regions and new experimental evidence that sensitive genotypes of aspen have increased mortality with ozone exposure, supports **a "likely to be causal relationship" between ozone exposure and tree mortality.**

In addition to effects on plants, ozone can alter ecological interactions between plants and other species including herbivores consuming ozone-exposed vegetation. Studies of insect herbivores in previous ozone assessments and newer experimental studies covering a range of species at varying levels of ozone exposure frequently show statistically significant effects; however, effects on growth and reproduction are highly context- and species-specific, and not all species tested show a response (Section 8.6). **The collective evidence supports "a likely to be causal relationship" between ozone exposure and altered herbivore growth and reproduction.** Many plant-insect interactions are mediated through volatile plant signaling compounds which plants use to signal other community members. In the 2013 Ozone ISA, a few experimental and modeling studies reported altered insect-plant interactions that are mediated through chemical signaling. New evidence from multiple studies show altered/degraded emissions of chemical signals from plants and reduced detection of volatile plant signaling compounds by insects, including pollinators, in the presence of ozone (Section 8.7). **The collective evidence supports "a likely to be causal relationship" between ozone exposure and alteration of plant-insect signaling.**

At the ecosystem scale, ozone-caused decreases in plant photosynthesis can lead to reduced ecosystem carbon content. Changes in patterns of aboveground and belowground carbon allocation associated with ozone effects on plants can alter ecosystem properties of storage (e.g., productivity, carbon sequestration) and cycling (e.g., biogeochemistry) through both experimental and modeling studies. Consistent with the conclusions of the 2013 Ozone ISA, there is **a "causal relationship" between ozone exposure and reduced productivity and a "likely to be causal relationship" between ozone and reduced carbon sequestration** (Section 8.8). As described in the 2013 Ozone ISA and new experimental studies, processes such as carbon and nitrogen cycling and decomposition in soils are indirectly affected via ozone effects on the quality and quantity of carbon supply from plants and leaf litter (Section 8.9). **Recent evidence continues to support a "causal relationship" between ozone exposure and the alteration of belowground biogeochemical cycles**. Ozone can affect water use in plants through several mechanisms including damage to stomatal functioning, loss of leaf area, and changes in wood anatomy (e.g., vessel size and density) that can affect plant and stand evapotranspiration and may lead, in turn, to possible effects on hydrological cycling as shown through a combination of experimental data and modeling (Section 8.11). Evidence continues to support the conclusion of the 2013 Ozone ISA that, **there is a "likely to be causal relationship" between ozone and alteration of ecosystem water cycling.** In terrestrial ecosystems, ozone may alter community composition by uneven effects on co-occurring species, decreasing the abundance of sensitive species, and giving tolerant species a competitive advantage. Alteration of community composition of some ecosystems including conifer forests, broadleaf forests, and grasslands and altered fungal and bacterial communities in soils reported in the 2013 Ozone ISA is augmented by additional experimental and modeling evidence for effects in forest and grassland communities (Section 8.10); collective evidence indicates a change in the causality determination to **a "causal relationship" between ozone exposure and altered terrestrial community composition of some ecosystems.**

For effects on climate, changes in the abundance of tropospheric ozone perturb the radiative balance of the atmosphere by interacting with incoming solar radiation and outgoing longwave radiation. This effect is quantified by radiative forcing.[1] Through this effect on the Earth's radiation balance, tropospheric ozone plays a major role in the climate system and increases in tropospheric ozone abundance contribute to climate change. **Recent evidence continues to support a "causal relationship" between tropospheric ozone and radiative forcing and a "likely to be causal relationship," via radiative forcing, between tropospheric ozone and temperature, precipitation, and related climate variables** (referred to as "climate change" in the 2013 Ozone ISA; the revised title for this causality determination provides a more accurate reflection of the available evidence; Table ES-3). The new evidence comes from the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) and its supporting references, as well as a limited number of more recent studies, and builds on evidence presented in the 2013 Ozone ISA. The new studies further support the causality determinations included in the 2013 Ozone ISA.

Table ES-3 Summary of causality determinations for tropospheric ozone effects on climate.

	Conclusions in 2013 Ozone ISA	Conclusions in the 2020 ISA
Radiative forcing	Causal relationship	Causal relationship
Temperature, precipitation, and related climate variables	Likely to be causal relationship	Likely to be causal relationship

[1] Radiative forcing is the perturbation in net radiative flux at the tropopause (or top of the atmosphere) caused by a change in radiatively active forcing agent(s) after stratospheric temperatures have readjusted to radiative equilibrium [stratospherically adjusted radiative forcing; Myhre et al. (2013)].

ES.5 Key Aspects of Health and Welfare Effects Evidence

There is extensive scientific evidence that demonstrates health and welfare effects from exposure to ozone. As documented by the evaluation of evidence throughout the subsequent Appendices to this ISA, the U.S. EPA carefully considers uncertainties in the evidence, the extent to which recent studies have addressed or reduced uncertainties from previous assessments, and the strengths of the evidence. Uncertainties do not necessarily change the fundamental conclusions of the literature base. In fact, some conclusions are robust to such uncertainties. Where there is clear evidence linking ozone with health and welfare effects—with or despite remaining uncertainties—the U.S. EPA makes a determination of a causal or likely to be causal relationship. The identification of the strengths and limitations in the evidence will help in the prioritization of research efforts to support future ozone NAAQS reviews.

ES.5.1 Health Effects Evidence: Key Findings

A large body of scientific evidence spanning many decades clearly demonstrates there are health effects related to both short- and long-term exposure to ozone. The strongest evidence supports a relationship between ozone exposure and respiratory health effects. The collective body of evidence for each health outcome category evaluated in this ISA is considered systematically and assessed; this assessment includes evaluation of the inherent strengths, limitations, and uncertainties in the overall body of evidence for the health outcome, resulting in the causality determinations detailed in Table ES-1.

An inherent strength of the evidence integration in this ISA is the extensive amount (in both breadth and depth) of available evidence resulting from decades of scientific research that describes the relationship between both short- and long-term ozone exposure and health effects. The breadth of the enormous database is illustrated by the different scientific disciplines that provide evidence (e.g., controlled human exposure, epidemiologic, animal toxicological studies), the range of health outcomes examined (e.g., respiratory, cardiovascular, metabolic, reproductive, and nervous system effects, cancer and mortality), and the large number of studies within several of these outcome categories. The depth of the literature base is exemplified by the examination of effects that range from biomarkers of exposure, to subclinical effects, to overt clinical effects, and even mortality.

There is strong and consistent experimental evidence linking short- and long-term ozone exposure with respiratory effects and short-term ozone exposure with metabolic health effects. However, several uncertainties should be considered when evaluating and synthesizing evidence from these studies. Experimental animal studies are often conducted at ozone concentrations higher than those observed in ambient air (i.e., 250 to >1,000 ppb) to evoke a response within a short time period. These studies are informative and the conduct of studies at these concentrations is commonly used for identifying potential human hazards. There are also substantial differences in exposure concentrations and exposure durations between animal toxicological and controlled human exposure studies. Additionally, a number of animal toxicological studies are performed in rodent models of disease states, while controlled human exposure studies generally are conducted in healthy individuals. Controlled human exposure studies do not typically include unhealthy or diseased individuals for ethical reasons; therefore, this exclusion represents an important uncertainty to consider in interpreting the results of these studies (i.e., that other individuals may be more sensitive and at risk to ozone than those in the study groups). Additional factors that differ between human and experimental animal exposures include: exposure concentration and disease status; differences in physiology (e.g., rodents are obligate nose breathers); differences in the duration and timing of exposure (e.g., rodents are exposed typically during the day, during their resting cycle, while humans are exposed during the day when they are normally active); and differences in the temperature at which the exposure was conducted. These factors may contribute to any lack of coherence between results of experimental animal and human studies. Despite these factors, there is consistent and coherent evidence that spans scientific disciplines for respiratory and metabolic health effects.

Epidemiologic studies contribute important evidence supporting the relationship between short- and long-term ozone exposure with respiratory effects. Although susceptible to chance, bias, and other potential confounding due to their observational nature, epidemiologic studies have the benefit of evaluating real-world exposure scenarios and can include sensitive populations that cannot typically be included in controlled human exposure studies. Innovations in epidemiologic study designs and methods have substantially reduced the role of chance, bias, and other potential confounders in well-designed, well-conducted epidemiologic studies. The most common source of uncertainty in epidemiologic studies of ozone is exposure measurement error. The exposure assignment methods used in short- and long-term ozone exposure epidemiologic studies have inherent strengths and limitations, and exposure measurement errors associated with those methods contribute bias and uncertainty to health effect estimates. For short-term exposure studies, exposure measurement error generally leads to underestimation and reduced precision of the association, whereas in long-term exposure studies exposure measurement error has the potential to bias effect estimates in either direction, although it is more common that they are underestimated. Furthermore, disentangling the effects of short-term ozone exposure from those of long-term ozone exposure (and vice versa) is an inherent uncertainty in the evidence base. When combined with coherent evidence from animal toxicological and controlled human exposure studies, the epidemiologic evidence can support and strengthen determinations of the causal nature of the relationship between health effects and exposure to ozone at relevant ambient air concentrations.

ES.5.2 Welfare Effects Evidence: Key Findings

The collective body of evidence for each welfare endpoint evaluated in this ISA was carefully considered and assessed, including the inherent strengths, limitations, and uncertainties in the overall body of evidence, resulting in the causality determinations for ecological effects detailed in Table ES-2 and effects on climate in Table ES-3. A large body of scientific evidence spanning more than 60 years clearly shows effects on vegetation due to ozone exposure. Decades of research on many plant species confirm effects on visible foliar injury, plant growth, reproduction and yield. The use of visible foliar injury to identify phytotoxic levels of ozone is an established and widely used methodology. There are robust exposure-response functions for reduced growth and yield (i.e., from carefully controlled experimental conditions, involving multiple concentrations and based on multiple studies) for about a dozen important tree species and a dozen major commodity crop species. Newer evidence supports a role for ozone in tree mortality and shifts in community composition of forest tree and grassland species. While the effect of ozone on vegetation is well established in general, there are some knowledge gaps regarding precisely which species are sensitive, what exposures elicit adverse responses for many species and how plant response changes with age and size.

There is high certainty in ozone effects on impairment to leaf physiology as mechanisms for effects at higher levels of biological organization (i.e., from the cellular level through individual organisms to the level of communities and ecosystems) and how those can ultimately affect aboveground and belowground processes such as productivity, carbon sequestration, biogeochemical cycling, and hydrology. However, ecosystems are inherently complex, and it is difficult to partition observed responses within a suite of multiple stressors. Scaling ozone effects to the ecosystem level remains a challenge, but there is a large body of knowledge of how ecosystems work through ecological observations and models. Interactive effects in natural ecosystems with multiple stressors (e.g., drought, disease) are difficult to study, but some have been investigated using different statistical methods. Although models and methods for characterizing ecosystem-level responses to ozone are accompanied by inherent uncertainties, more research will strengthen understanding of scaling across different levels of biological organization.

There are multiple pathways in which ozone can affect plant-insect interactions. Studies that characterize volatile plant signaling compounds in ozone-enriched environments and assess insect response to altered chemical signals suggest that ozone alters scent-mediated interactions in ecological communities. A relatively small number of insect species and plant-insect associations have been assessed, and there are knowledge gaps in the mechanisms and consequences of modulation of signaling by ozone. There are multiple studies demonstrating ozone effects on fecundity and growth in insects that feed on ozone-exposed vegetation. However, no consistent directionality of response is observed across studies and uncertainties remain in regard to different plant consumption methods across species and the exposure conditions associated with particular severities of effects.

Changes in the abundance of tropospheric ozone affect radiative forcing, and thus tropospheric ozone is considered an important greenhouse gas. The recent IPCC AR5 estimates global tropospheric ozone radiative forcing to be 0.40 (0.20 to 0.60) W/m^2 and recent studies reinforce the AR5 estimates. Consistent with previous estimates, the effect of global, total tropospheric ozone increases on global mean surface temperature, through its impact on radiative forcing, continues to be estimated at roughly 0.1 to 0.3°C since preindustrial times with larger effects regionally. Some new research has explored certain additional aspects of the climate response to ozone radiative forcing beyond global and regional temperature change. Specifically, ozone changes are understood to have impacts on other climate metrics such as precipitation and atmospheric circulation patterns, and new evidence has continued to support and further quantify this understanding.

While the warming effect of tropospheric ozone in the climate system is well established in general, precisely quantifying changes in surface temperature due to tropospheric ozone changes, along with related climate effects, requires complex climate simulations that include all relevant feedbacks and interactions. For example, trends in free tropospheric ozone and upper tropospheric ozone (where radiative forcing is particularly sensitive to changes in ozone concentrations) are not captured well by models. In addition, substantial variation exists across models. Such modeling uncertainties make it especially difficult to provide precise quantitative estimates of the climate effects of regional-scale ozone changes. Uncertainties in estimates of preindustrial ozone concentrations represent another important source of uncertainty in climate effects resulting from long-term ozone concentration changes.

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Ozone Advance Path Forward

Prepared by the New Mexico Environment Department
Air Quality Bureau

Submitted to United States Environmental Protection Agency, Region VI
July 2021

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Table of Contents

Introduction

Ozone Basics

Ozone (O_3) is a highly reactive gas composed of three oxygen atoms. It is both a natural and a man-made product that occurs in the Earth's upper (stratosphere) and lower (troposphere) atmosphere. Ground level ozone, the ozone EPA sets national standards for, is both harmful to human health and damaging to the environment

Both short- and long-term exposure to ozone can lead to adverse health impacts. Short-term exposures to ozone can make it more difficult to take a full, deep breath by inflaming the airways and causing symptoms such as chest pain, coughing, wheezing and shortness of breath. These short-term exposures can also aggravate asthma and other respiratory diseases and can make people more susceptible to infections.

Long-term exposure to ozone is linked to the development and aggravation of asthma and a variety of other impacts to the respiratory system. Through continued research, scientists are finding that long-term exposure (i.e., for periods longer than eight hours) may increase the risk of early death. Anyone who spends time where ozone concentrations are high may be at risk of experiencing adverse health effects.[1]

According to the Environmental Protection Agency (EPA), ozone affects sensitive vegetation and ecosystems, including forests, parks, wildlife refuges and wilderness areas. Ozone can especially cause damage during the growing season. When enough ozone enters the leaves of a sensitive plant, it can reduce photosynthesis; slow the plant's growth; and increase sensitive plants' risk of disease, damage from insects, effects of other pollutants, and harm from severe weather. [2]

EPA Advance Program

The EPA Advance Program began in April 2012 as a collaborative effort to encourage ozone and particulate matter (PM) emission reductions in attainment areas. Participants determine goals and measures they want to implement and achieve. Although participation in the program does not guarantee an attainment designation in the future, actions taken as part of the Ozone Advance Program could better position future non-attainment areas to develop an effective State Implementation Plan (SIP).

Ozone Advance provides emissions reductions that could result in a lower nonattainment classification or be credited in a future SIP. A key benefit to participating in the program is the flexibility to voluntarily reduce air pollution through control measures chosen to suit an area’s social and economic demographics. Once designated nonattainment, the Clean Air Act affords less flexibility to select control measures.

Geographic Scope

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[1] From *Health effects of ozone pollution*, Environmental Protection Agency, https://www.epa.gov/ground-level-ozone-pollution/health-effects-ozone-pollution
[2] From *Ecosystem effects of ozone pollution*, Environmental Protection Agency, https://www.epa.gov/ground-level-ozone-pollution/ecosystem-effects-ozone-pollution

The New Mexico Environment Department (NMED) is participating in the Ozone Advance Program with respect to three full counties and one partial county in New Mexico to preserve or improve the air quality in these areas. These counties are San Juan (northwest NM), Lea (southeast NM), Eddy (southeast NM) and Doña Ana, excluding the Sunland Park nonattainment area (south central NM). Since our acceptance into the Ozone Advance Program in April 2019, ozone levels in Rio Arriba, Sandoval, Santa Fe, and Valencia counties either currently or recently have exceeded 95% of the 2015 8-hour Ozone NAAQS (67 ppb) and could soon violate this standard. In total, the Ozone Advance Path Forward and outreach efforts will include the following nine counties (figure 1): Chaves, Doña Ana, Eddy, Lea, Rio Arriba, San Juan, Santa Fe, Sandoval, and Valencia.

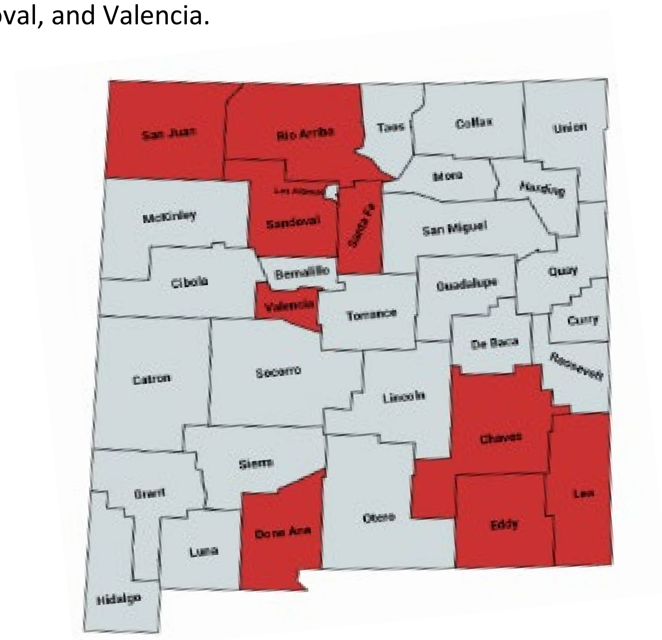

Figure 1: Map of New Mexico Counties to be included in Ozone Advance Path Forward

Although Chaves County does not have ozone monitors, the Bureau will include it in the Ozone Advance planning effort as it is part of the Permian Basin with Oil and Gas emissions that contribute to high ozone levels in Lea and Eddy counties. NMED understands our efforts under Ozone Advance may benefit these areas by potentially (1) reducing air pollution in terms of ozone as well as other air pollutants, (2) ensuring continued healthy ozone levels, (3) maintaining the ozone NAAQS and helping the Sunland Park Nonattainment Area attain the 2015 Ozone NAAQS, (4) helping avoid violations of the NAAQS that could lead to a future nonattainment designation, (5) increasing public awareness about ozone as an indirect air pollutant, and (6) targeting limited resources toward actions to address ozone problems quickly. NMED's goal is to implement measures and programs to reduce ozone in the near term, and ultimately to effect changes that will protect community well-being into the future. NMED agrees it is in our best interest to work together and in coordination with stakeholders and the public to proactively pursue this goal.

This path forward plan outlines several relevant strategies to realize this vision. It recommends measures that we, as a state, can and are implementing to protect air quality across New Mexico.

Background

Ground-level ozone is created by chemical reactions between nitrogen oxides (NO_X) and volatile organic compounds (VOCs), with sunlight as the driver. VOC and NO_X come in two forms: biogenic (natural), which is produced by vegetation: and anthropogenic, which is created by humans, primarily in industrial processes, and by modern transportation modes, particularly diesel and gas-driven motor vehicles. Hot, sunny days may produce unhealthy levels of ozone, especially in urban environments. Smoke from wildfires can also contribute pollutants that increase the formation of ozone.

High ozone levels in New Mexico are driven by different sources in different parts of the state. For example, NO_X and VOC emissions from the oil and gas industry in Eddy, Lea, Rio Arriba and San Juan counties combined with abundant desert sunshine create some of the highest ozone levels in New Mexico. Likewise, plentiful sunshine mixed with concentrated vehicle emissions in the Albuquerque metro area contribute to high ozone in the Sandoval and Valencia counties. By and large, Doña Ana County's high ozone levels are influenced by emissions from the large metropolitan area of El Paso, Texas and Juárez, Mexico.

Ozone Monitoring & Trends

The Air Quality Bureau (AQB) operates and maintains fourteen (14) continuous ozone monitors across the state. Except for a small portion of Doña Ana County near the City of Sunland Park, all of New Mexico is currently classified as "attainment" for the 2015 8-hour ozone NAAQS. The Sunland Park area's ozone levels are largely influenced by sources and emissions from outside of New Mexico.

Although the health-based ozone standard is set at .070 ppm, New Mexico law [74-2-5.3 NMSA 1978] requires that NMED develop plans to reduce ozone once monitored design values (DVs) in an area that exceed 95% of the standard (i.e., 0.067 ppm). In Table 1, 2018-2020 Design Value data indicate ozone levels at or above 95% of the ozone NAAQS at several New Mexico air quality monitors in eight counties.

County	Monitoring Location	2018-2020 Design Value
Doña Ana	La Union	70 ppb
	Chaparral	72 ppb
	Desert View	78 ppb
	Santa Teresa	74 ppb
	Solano	70 ppb
Eddy	Carlsbad	78 ppb
Lea	Hobbs	68 ppb
Rio Arriba	Coyote Ranger Station	65 ppb
Sandoval	Bernalillo	70 ppb
San Juan	Bloomfield	66 ppb
	Navajo Lake	68 ppb
	Substation	69 ppb
Santa Fe	Santa Fe	68 ppb
Valencia	Los Lunas	69 ppb

Table 1: 2018-2020 Design Values for Monitoring Locations in New Mexico

As shown in Figure 2, DVs for Doña Ana County have consistently exceeded the 2015 NAAQS standards, and have been continuing to rise since 2016-2018.

Eddy and San Juan counties' DVs remained constant from 2010-2012 through 2012-2014, dropped from 2013-2015 through 2014-2016, rose modestly from 2015-2017, then increased sharply from 2016-2018 through 2017-2019. San Juan has managed to remain just under the 2015 NAAQS standards in 2018-2020, but Eddy has shown a dramatic increase in ozone levels with a peak of 79 ppb in 2017-2019.

Sandoval County and Lea County have shown steady increases in ozone DVs between 2010-2012 and 2018-2020, rising from 61 to 70 ppb and 61 to 68 ppb, respectively. Valencia county has been steadily rising since 2014-2016.

The monitoring site at Rio Arriba first reported in 2014-2016 with an ozone DV of 64 ppb and rose to reach a peak of 70 ppb in 2017-2019, then decreased to 65 ppb for 2018-2020.

Between 2013-2015 and 2015-2017, all counties except Dona Ana showed a decrease in ozone DVs beginning to rise. Rio Arriba, Eddy, and Lea all had decreases in DV in 2018-2020, with the rest of the counties still rising.

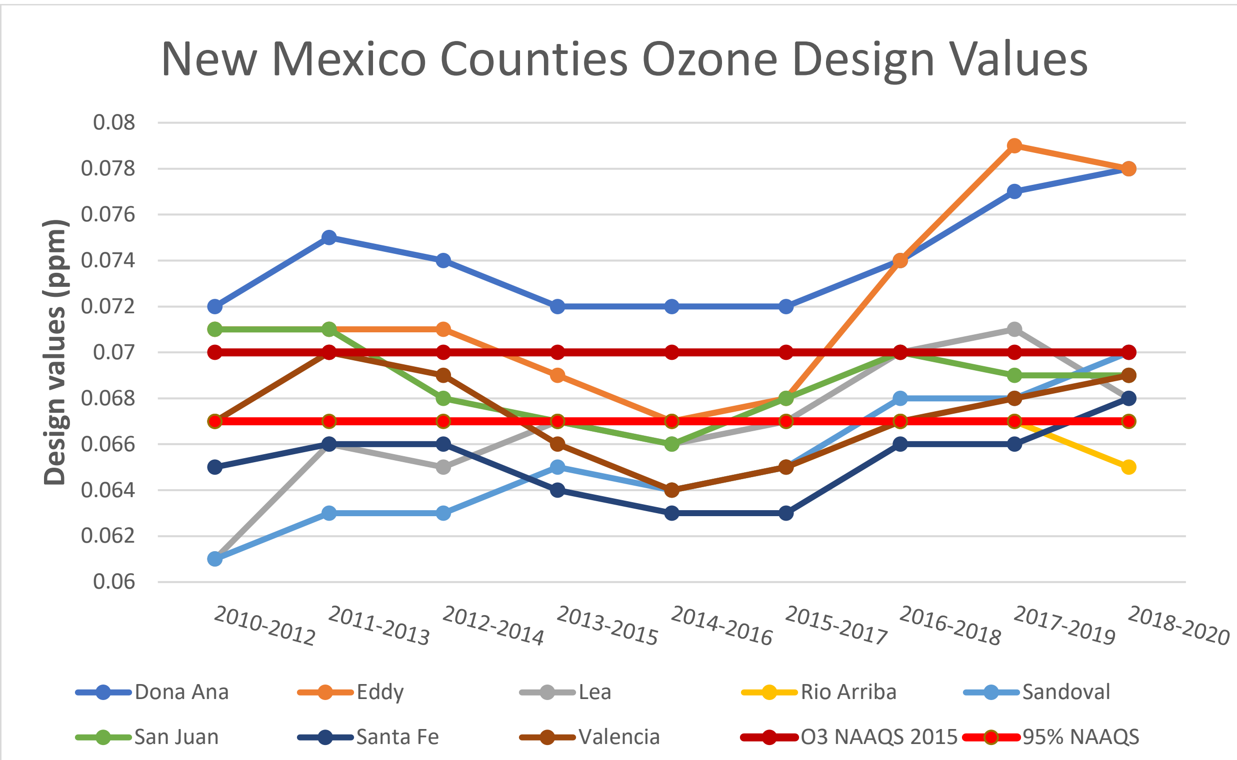

Figure 2: Design values for New Mexico counties included in the Advance Program, 10-year trends

Key Sources of Ozone and Precursor Pollutants

In addition to historical design value trends from 2010 through 2020, the 2017 NEI data was used to identify the major source categories. The National Emissions Inventory (NEI) is a comprehensive and detailed estimate of air criteria pollutant emissions, precursors, and hazardous air pollutants from air emissions sources.[3] Air pollution sources are separated into main source categories – point, nonpoint, on-road, and nonroad.

The point source category contains larger sources that are located at fixed, stationary locations. It includes large and certain smaller industrial facilities, (e.g., electric power plants, airports, non-industrial, and

[3] From *National Emissions Inventory*, Environmental Protection Agency, https://www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei

commercial facilities). This category also includes a small number of portable sources, such as some asphalt or rock crushing operations, aircraft engine emissions (occurring during landing and takeoff operations), airport ground support and power unit equipment, and locomotive emissions at rail yards.[4]

Nonpoint sources include sources that individually are too small in magnitude to report as point sources. Examples include residential heating, commercial combustion, asphalt paving, and commercial and consumer solvent use. Non-railyard locomotive emissions, commercial marine vessel emissions (both underway and port emissions), dry cleaners, gas stations, and livestock facilities are also included as nonpoint sources.[5]

On-road sources are vehicles that use gasoline, diesel, and other fuels. These sources include light-duty and heavy-duty vehicles from operation on roads, highway ramps, and during idling.[6] Nonroad sources consist of off-road mobile sources that use gasoline, diesel, and other fuels. Source types in this category include construction equipment, lawn and garden equipment, locomotives, and commercial marine vessels.[7]

General NO_X and VOC Emission Trends

The National Emissions Inventory provides data on criteria pollutants to better understand current emissions in different areas. Several monitors are placed throughout New Mexico which collect and report data spanning multiple years. Table 2 shows total emissions in tons of NO_X and VOCs reported in the 2017 NEI in the counties that are included in the Ozone Advance Program. Both NO_X and VOCs are precursors of ozone, meaning they interact with other compounds in the atmosphere to create ozone.

	Dona Ana	Chaves	Eddy	Lea	Rio Arriba	Santa Fe	San Juan	Sandoval	Valencia
NOx	6,503	X,xxx	4,418	7,493	1,512	3,999	23,135	2,556	1,656
VOC	3,508	X,xxx	6,380	1,779	1,744	2,047	5,599	1,475	6,289

Table 2: 2017 NEI NOx and VOC Emissions in tons for New Mexico Ozone Advance Counties

NOx Emissions

Overall, San Juan County has the highest levels of estimated NO_X emissions at 23,135 tons. Doña Ana and Lea counties' NO_X emission estimates are 6,503 tons and 7,493 tons, respectively. NO_X emissions for Eddy, Rio Arriba, Santa Fe, Sandoval, and Valencia counties are estimated below 5,000 tons for each county.

Eddy, Valencia, and San Juan counties have the highest and nearly equal estimated levels of VOC emissions at 6,380; 6,289; and 5,600 tons; respectively. Likewise, Lea, Rio Arriba and Sandoval counties had nearly equal but much lower estimated levels of VOC emissions at 1,779; 1,745; and 1,475 tons, respectively. Doña Ana County's estimated VOC emissions were 3,508 tons, with Santa Fe County at approximately 2,047 tons.

[4] Ibid.
[5] Ibid.
[6] Ibid.
[7] Ibid.

According to 2017 NEI data shown in Figure 3, the on-road sector accounts for 61% (Rio Arriba) to as much as 96% (Santa Fe) of estimated NO_X emissions in Doña Ana, Rio Arriba, Santa Fe, Sandoval, and Valencia counties. The percentage of on-road NO_X emissions in Eddy, Lea, and San Juan County are considerably lower at 28%, 20%, and 9%, respectively.

Point sources in San Juan account for 90% estimated NO_X emissions in the county, this is 32% of all NO_X emissions in the counties that are a part of the Ozone Advance plan. Lea County point source emissions account for 76% of NO_x emissions in the county. Percentages for point source estimated NO_X emissions for Eddy and Rio Arriba counties are significantly lower at 26% and 21%, respectively. Doña Ana and Valencia have low estimated NO_X emissions at 15% and 11%, respectively, of the total NO_X emissions for those counties. Santa Fe County point source emissions only account for 1.5% of NO_x and Sandoval County's point source emissions are negligible at <1%.

Of all nine counties, Eddy County's Nonpoint sources are the greatest at 45% of estimated NO_X emissions. Rio Arriba County's nonpoint source emissions account for 13% of NO_X emissions. Santa Fe, Sandoval, Valencia, Doña Ana, Lea, and San Juan counties have 5% or less of nonpoint NO_X emissions.

Non-road sources account for less than 10% of total estimated NO_X emissions for Doña Ana, Eddy, Lea, Rio Ariba, San Juan, Santa Fe, and Valencia counties. Sandoval is the only county with non-road estimated NO_X emissions slightly higher at 14%.

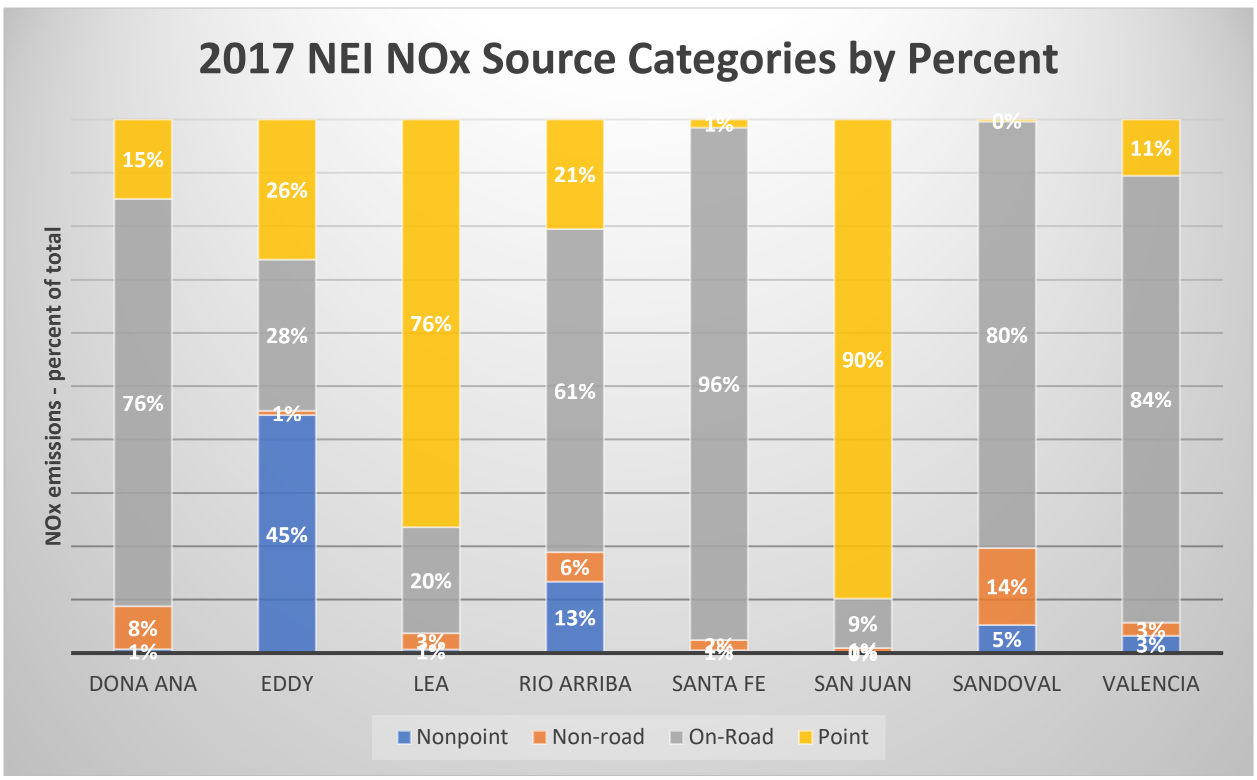

Figure 3: 2017NEI NOx Source Categories for Counties within 95% of the Ozone Standard.

<u>VOC Emissions</u>

According to 2017 NEI data (Figure 4), on-road source emissions in Santa Fe, Sandoval, and Doña Ana counties are 88%, 83%, and 64%, respectively, of the total estimated VOC emissions for these counties. Lea, Rio Arriba, & San Juan counties have moderate percentages of VOC emissions, between 21% and 38% from the on-road source sector. Eddy and Valencia counties have relatively low on-road VOC emissions at 9% and 12%, respectively.

Valencia and Eddy counties have the highest percentage of nonpoint VOC emissions at 87% and 78%, respectively. San Juan County has a moderately high percentage of nonpoint VOC emissions at 44%. Lea, Rio Arriba, and Doña Ana counties have relatively low percentages of nonpoint VOC emissions between 18% and 29%. Santa Fe and Sandoval Counties have a low percentage of nonpoint VOC emissions at 5% and 8% respectively.

Rio Arriba, Lea, and San Juan counties have moderately high percentages of point source VOC emissions at 43%, 42% and 33%, respectively. Eddy, Doña Ana, & Sandoval counties have point source VOC emissions percentages of 10% and less. Santa Fe County has the second lowest point source VOC emissions with just 1% and Valencia County's point source emissions are negligible at <1%. All seven counties have relatively low percentages of non-road VOC emissions of 11% or less.

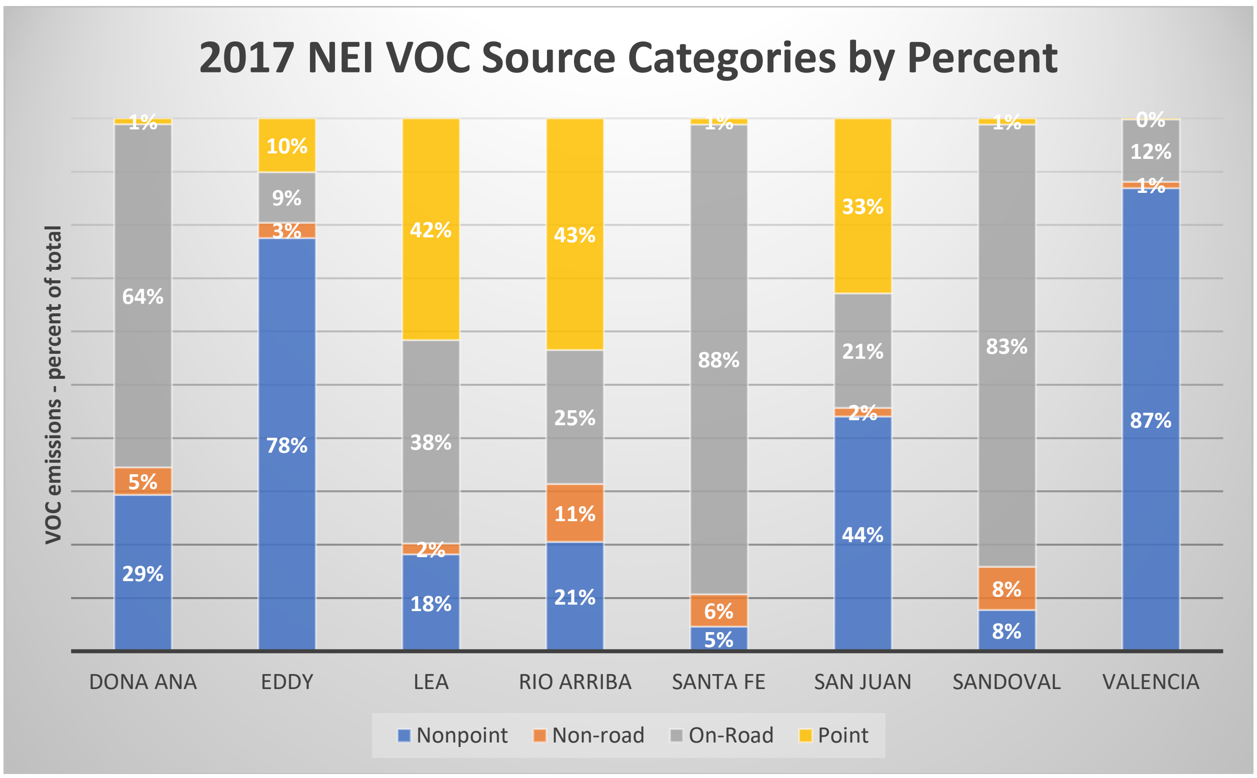

Figure 4: 2017 NEI VOC Source Categories for Ozone Advance Counties

Technical Analyses and Modeling

There are four interrelated but distinct conceptual models of ozone formation within New Mexico's airsheds: Albuquerque and surrounding areas, southcentral New Mexico, southeastern New Mexico, and northwestern New Mexico. They share the attribute that ozone transport from outside of New Mexico and/or the continental U.S. dominates ozone concentrations on all days. Days with the highest local ozone formation are typically hot summer days with slow winds and without an excessive amount of precipitation (summer monsoon).[8] To study how ozone forms in the state, NMED has participated in photochemical modeling studies over the past twenty years. Most recently, photochemical modeling was completed in May of 2021 for New Mexico's draft ozone rule with a focus on the counties included in this path forward.

Photochemical Modeling for New Mexico

The modeling study for the draft ozone rule leverages the 2014 Photochemical Grid Model (PGM) modeling platform developed by the Western Regional Air Partnership (WRAP) in the Western Air Quality Study (WAQS). It enhances the PMG by adding a 4-km grid resolution modeling domain over New Mexico and surrounding areas, especially the oil and gas production regions in the Permian and San Juan Basins. The PGM modeling consists of 2014 base year modeling and model performance evaluation as well as 2028 future year modeling. The results of the 2028 future year modeling, source apportionment and control measure evaluation will assist the NMED in ozone air quality planning and rule development for the state.[9]
Preliminary conclusions indicate the draft ozone rule would reduce projected 2028 ozone DVs across New Mexico when compared to 2012-2016 DVs (Table 3). While the DVs from 2012-2016 show most sites to be within attainment of the NAAQS standards and the 95% threshold set for Ozone Advance, it should be noted that all sites have shown increases in Ozone levels in recent years (Table 1). The largest DV reductions by site are projected to be at the La Union monitoring site in Dona Ana County (6.3 ppb) and the Bernalillo site in Sandoval County (5.6 ppb).

The photochemical modeling shows a total of 60.3 ppb of ozone reduced in the Ozone Advance counties as a result of the Proposed Ozone Rule. Tables 3-5 show the predicted changes in DVs at 15 monitoring sites in the Ozone Advance counties in New Mexico.

	Site	2012-2016 DVC (ppb)	2028 DVF (ppb)	Difference
Rio Arriba	Coyote Ranger District	64	60.8	-3.2
Sandoval	Bernalillo	64	58.4	-5.6
San Juan	Bloomfield	64.3	61	-3.3
	Navajo Lake	67	64.8	-2.2
	Substation	63.7	60.8	-2.9
Santa Fe	Santa Fe Airport	64.3	60.6	-3.7
Dona Ana	La Union	66.3	60	-6.3
	Sunland Park City Yard	67	61.9	-5.1
	Chaparral	67	62.3	-4.7
	Desert View	72	67	-5.0
	Santa Teresa	71.3	66.1	-5.2
	Solano	65	60.3	-4.7
Eddy	Carlsbad	69	66.7	-2.3
Lea	Hobbs Jefferson	66	64	-2.0
Valencia	Los Lunas	66.3	62.2	-4.1

Table 3: Differences in Design Values in ppb by Site in Ozone Advance Counties throughout New Mexico

[8] New Mexico Ozone Attainment Initiative Photochemical Modeling Study – Draft Modeling Protocol, May 2020, Ramboll, https://www.wrapair2.org/pdf/NM_OAI_Modeling_Protocol_v5.pdf
[9] Ibid.

County	Site Difference Average (ppb)
San Juan	-2.8
Dona Ana	-5.2

Table 4: Average ozone Design Value differences in counties with multiple monitors.

County	Total Ozone Reduced (ppb)
Rio Arriba	-3.2
Sandoval	-5.6
San Juan	-8.4
Santa Fe	-3.7
Dona Ana	-3.1
Eddy	-2.3
Lea	-2.0
Valencia	-4.1

Table 5: Total projected reductions in ozone as a result of the proposed rule.

Path Forward – Planning Measures and Emission Reduction Strategies

Ozone Attainment Initiative and Ozone Precursor Rulemaking

To address the high observed ozone concentrations in New Mexico, the NMED has embarked on an Ozone Attainment Initiative ("OAI")[10] to protect the ozone attainment status of the state and ensure health and welfare of the residents of the state for future generations.[11] In total, the Initiative's planning and outreach efforts will include the following nine counties: Chavez, Doña Ana, Eddy, Lea, Rio Arriba, San Juan, Santa Fe, Sandoval and Valencia. This Initiative is undertaken pursuant to the Air Quality Control Act at NMSA 1978, Section 74-2-5(C), which states:

> If the environmental improvement board ... determines that emissions from sources within [its] jurisdiction cause or contribute to ozone concentrations in excess of ninety-five percent of a national ambient air quality standard for ozone…[the] board shall adopt a plan, including rules, to control emissions of oxides of nitrogen and volatile organic compounds to provide for attainment and maintenance of the standard.

The OAI is a multi-year planning effort, beginning in the summer of 2018 and continuing indefinitely, as necessary. Three phases of implementation include: (1) an effort to educate the public and gather initial information and ideas; (2) development of appropriate rules and other programs based on scientific analysis and public input; and (3) development and implementation of the OAI plan, including rules to control sources contributing significantly to high ozone levels. NMED intends to use this Ozone Advance Path Forward document as the OAI plan required by New Mexico's Air Quality Control Act.

Ozone Precursor Rule – 20.2.50 NMAC, Oil and Gas Sector

[10] From *Ozone Attainment Initiative*, NMED, https://www.env.nm.gov/air-quality/o3-initiative/

[11] New Mexico Ozone Attainment Initiative Photochemical Modeling Study – Draft Modeling Protocol, May 2020,Ramboll, https://www.wrapair2.org/pdf/NM_OAI_Modeling_Protocol_v5.pdf

Beyond the statutory authority provided to NMED by the Air Quality Control Act, Governor Michelle Lujan Grisham issued Executive Order ("E.O.") 2019-003, which directs NMED and the New Mexico Energy, Minerals, and Natural Resources Department ("EMNRD") to "jointly develop a statewide, enforceable regulatory framework to secure reductions in oil and gas sector methane emissions and to prevent waste from new and existing sources". EMNRD adopted rules effective at the beginning of 2021 that prohibits venting and limits flaring at oil and gas well sites to minimize methane emissions.

Under the statutory authority of the OAI and E.O. 2019-003, the Department has developed its first rule to reduce emissions of ozone precursors. Regulations developed under the OAI to reduce emissions of ozone precursor pollutants will have the co-benefit of reducing methane emissions because methane is released along with volatile organic compounds in oil and gas operations. Thus, the Department worked in close coordination with EMNRD in developing 20.2.50 NMAC, and the agencies endeavored to align their respective regulatory regimes as much as possible to avoid duplicative or conflicting requirements.

Beginning in the summer of 2019, the Department began an extensive stakeholder and public outreach process for its OAI and the NMED/EMNRD joint Methane Strategy. In June through August of 2019, NMED and EMNRD held numerous meetings throughout the State to provide information regarding the need for the regulatory initiatives and the relevant authorities for the regulatory actions; to hear input from stakeholders and members of the public; and to answer questions regarding the rulemaking process.

The agencies also convened a Methane Advisory Panel ("MAP"), consisting of technical stakeholders focusing on processes and equipment associated with oil and gas exploration, production, gathering, and processing. The MAP was comprised of 27 members with expertise in various parts of the oil and gas industry and included local and national environmental nongovernmental organizations as well as major and independent industry representatives from the upstream and midstream sectors. Additional expertise was provided by representatives from Los Alamos National Laboratory, Colorado State University, and the New Mexico Institute of Mining and Technology. The MAP met every other week over a four-month period and covered technical topics related to controlling VOC and methane emissions from equipment and operations employed in the oil and natural gas sector. Draft topic reports and all meeting presentations from the MAP meetings were posted online on both agencies' websites. In December of 2019, the MAP released a technical report for public review and input, and the agencies accepted comments on the report through February 20, 2020.

On July 20, 2020, NMED released an early stakeholder engagement draft of its ozone precursor regulation for the purpose of soliciting public and stakeholder input. In August of 2020, the Department met with stakeholder groups and held a public listening session during which participants were encouraged to provide both verbal and written feedback. The Department accepted written comments on the preliminary draft through September 20, 2020. A total of 524 written comments were received during the two-month comment period. From September 2020 through May 2021, the Department reviewed the input received from stakeholders and the public and made substantial revisions to the regulation based on that input.

The proposed draft regulation is the result of this two-year process of extensive public and stakeholder outreach and engagement, all of which is in addition to the public hearing process provided for by the Board's rulemaking procedures at 20.1.1 NMAC. the Department will continue to work diligently beyond the requirements of those procedures to communicate and work with stakeholders and the public regarding the proposed regulation and the hearing process to ensure that everyone who has an interest in the rules can participate in the rulemaking process to the fullest extent possible. NMED's proposed rule will be brought before the Environmental Improvement Board ("Board") for adoption at a public hearing scheduled to begin on September 20, 2021.

Low Emission/Zero Emission Vehicle Standard

In 2019, Gov. Lujan Grisham announced New Mexico will adopt clean car standards that are more stringent than the federal standards. Pollution from transportation accounts for a large portion of New Mexico's greenhouse gas emissions and contributes heavily to the area's growing ozone problem. New Mexico's rule will adopt California's Low-Emission Vehicle criteria pollutant and greenhouse gas emission regulations and Zero-Emission Vehicle regulations under Section 177 of the Clean Air Act (42 U.S.C. §7507). The timeline for New Mexico to adopt the CA standards is in development, but the standards are likely to have an impact in areas with high levels of on-road emission sources.

DERA Program

In 2005, the U.S. Congress passed the Diesel Emission Reduction Act (DERA) as an amendment to the Energy Policy Act. DERA was designed to reduce diesel emissions from existing diesel fleets that did not meet the recently adopted federal emission standards. The goal of the New Mexico Clean Diesel Program is to reduce the amount of air pollution created by diesel-fueled heavy-duty trucks and buses to which the residents of New Mexico are exposed.[12] Diesel-powered vehicles and equipment account for nearly half of all NO_x and more than two-thirds of all PM emissions from US transportation sources.[13] Since 2008, NMED has administered grant funds for the qualifying diesel emissions reduction projects in San Juan, McKinley, Luna, Santa Fe, Taos, and Bernalillo counties:

- School bus retrofits in Bloomfield, Central Consolidated, Farmington, and Gallup/McKinley County School District;
- Replacement of diesel vehicles with natural gas vehicles for the cities of Deming and Santa Fe, Taos County, and Albuquerque Public Schools; and
- Dock outlets for trailer refrigeration units, aerodynamic fairings, and low rolling resistance tires for New Mexico Association Food Banks.

VW Settlement

In 2015, Volkswagen admitted to purposely employing defeat devices on emissions controls for NOx on some of their Volkswagen, Audi, and Porsche diesel-fueled vehicles. In 2017, the U.S. District Court for the Northern District of California finalized Consent Decrees between Volkswagen, the United States, and the State of California, adopting revisions made by the Trustee. New Mexico was eligible to receive over $17,900,000 to be used for NO_x emission reduction projects.[14]

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[12] From *Diesel Emissions Reduction Act*, NMED, https://www.env.nm.gov/air-quality/diesel/

[13] From *Smog, Soot, and Other Air Pollution from Transportation*, Environmental Protection Agency, https://www.epa.gov/transportation-air-pollution-and-climate-change/smog-soot-and-local-air-pollution

[14] From *Volkswagen Settlement Information Fact Sheet*, NMED, https://www.env.nm.gov/wp-content/uploads/sites/26/2017/03/VW_Settlement_InBrief_November2017-1.pdf

The NMED has had two rounds of funding for the Volkswagen Settlement Allocation. NMED approved funding for seven projects in the first funding cycle and 43 projects in the second funding cycle of New Mexico's Volkswagen Settlement Allocation.

First funding cycle projects include new school buses in the Gallup-McKinley and Albuquerque School Districts; a new Public Works Vehicle for San Juan County; electric ground support equipment and associated infrastructure for Southwest Airlines and the Albuquerque International Sunport; as well as compressed natural gas-powered refuse vehicles; and replacing diesel delivery trucks for Sysco Leasing. In total, 123 vehicles in New Mexico were replaced or repowered, reducing NO_x emissions from both on-road and off-road diesel-fueled vehicles and equipment by roughly 160 tons in urban, rural, and Native communities in New Mexico.

In 2019, the Beneficiary Mitigation Plan (BMP) was revised and directed the remaining unallocated funds for future funding cycles to be used for the replacement of diesel-fueled vehicles with electric vehicles (EV), alternate-fueled vehicles, and light-duty zero emission vehicle (LDZEV) supply equipment. These projects will reduce emissions of NO_X by more than 40 tons in areas of New Mexico where residents bear a disproportionate share of NO_X pollution and in areas that are nearing the 2015 National Ambient Air Quality Standard for ground-level ozone.

The State remains committed to allocating the remaining 15% of the total funding (approximately $2.7 million) towards LDZEV infrastructure and has added a goal to focus efforts on a complete statewide electric vehicle charging network.[15]

Provisions for Public and Stakeholder Involvement

The AQB will conduct presentations for the industry, local governments, environmental groups, and school districts to garner support and participation in Ozone Advance. Also, the AQB will hold outreach and education events for businesses and private citizens to involve them in developing a "path forward" program for implementation. This will be done through a variety of projects including the existing partnerships and air quality improvement groups that NMED participates in and the creation of the Permian Basin Air Quality Task Force. NMED will provide additional opportunities to gather stakeholder input, hold ozone community workshops and develop voluntary ozone alert programs. Periodic update meetings will be held to keep stakeholders informed of progress and study results (e.g. rulemaking and modeling results) for all ozone advance path forward initiatives. This will allow for continuous feedback and participation as voluntary control measures, rules and programs are developed.

Joint Advisory Committee

On May 7, 1996, the United States and Mexico included Appendix 1 to Annex V to the "La Paz Agreement" that defined the bi-national Paso del Norte Air Basin and created the committee The Joint Advisory Committee (JAC) is a bi-national group charged with the development and recommendation of air quality improvement initiatives under the La Paz Agreement and EPA's Border Program (i.e., Border 2025). It is comprised of a mixture of federal, state, and local government officials along with private citizens, university officials, and non-governmental organizations from the United States and Mexico. The JAC is governed by operating procedures contained in their by-laws and meets triennially at a rotating location in southern Dona Ana County, New Mexico, El Paso, Texas and Cd. Juárez, Mexico. The JAC's priorities are

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[15] From *Volkswagen Settlement*, NMED, https://www.env.nm.gov/vw-settlement/

developed from the ground up, building upon local stakeholder input and concerns. All JAC meetings are open to the public and time is set aside at the beginning and end of each meeting for public comments.

Four Corners Air Quality Group

The original purpose of the 4CAQTF was to bring together a diverse group of interested parties to learn about and discuss air quality issues in the Four Corners area. Increased development in the Four Corners area including power plants, oil and gas production, and population growth were contributing to air quality concerns. Ozone levels in the region were close to exceeding the health-based national air quality standards for outdoor air. Task Force members developed a broad list of options for improving air quality in the area to aid the regulatory agencies in managing air quality impacts. These options were included in a report that was finalized in November 2007.[16]

Initial work of the 4CAQTF resulted in the implementation of one "interim" recommendation: the Bureau of Land Management required new and replacement internal combustion gas field engines to comply with more stringent emission standards in New Mexico and Colorado. These requirements apply to oil and gas development within the Bureau of Land Management's jurisdiction.[17] As a result of this work, the 4CAQTF continues to operate as the Four Corners Air Quality Group.

The Four Corners Air Quality Group (4CAQG) is a forum for individuals interested in air quality to meet, learn about current conditions, review progress on mitigation of air quality impacts, and generally contribute to clean air in the Four Corners Area. The 4CAQG includes NMED, Colorado Department of Public Health and Environment, US EPA, US Department of the Interior's National Park Service and Bureau of Land Management, US Department of Agriculture's Forest Service, the Southern Ute Indian Tribe, and the Navajo Nation. The Group meets at least once per year and more often if circumstances warrant it.

Permian Basin Air Quality Task Force

The NMED plans to create the Permian Basin Air Quality Task Force to bring together a diverse group of interested parties to learn about and discuss air quality issues in the Permian Basin. Increased oil and gas well development and population growth in the Permian Basin are contributing to air quality concerns. Ozone levels in the region are close to exceeding the health-based national air quality standards.

The first step will be to engage the Texas Commission on Environmental Quality (TCEQ) and the U.S. EPA to join NMED as a founding task force partner. Once this trilateral commitment is established, we can engage and invite other stakeholders in the basin to become task force partners. Potential stakeholders include the oil and gas industry, local governments, environmental groups, and concerned citizens.

The Group will meet annually, biannually, and more often when necessary to discuss rule planning and initiatives. The Task Force members will be encouraged to develop a broad list of options that will aid the regulatory agencies in managing air quality impacts and improving air quality in the basin. These options will be included in a final report.

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[16] From *Four Corners Air Quality Group*, NMED, https://www.env.nm.gov/air-quality/fcaqg/

[17] Four Corners Air Quality Task Force Report of Mitigation Options, November 2007, https://www.env.nm.gov/wp-content/uploads/sites/2/2016/11/4CAQTF_Report_FINAL.pdf

Gather Stakeholder Input

Understanding the concerns of impacted communities and stakeholders is an important part of creating an effective plan. As part of this initiative and in addition to the air quality groups listed above, NMED will hold meetings with various groups of stakeholders including environmental groups, tribes, the public, the regulated community, and local governments. The goal of these meetings will be to gather information about stakeholder concerns regarding ozone in their respective region and identify popular strategies that stakeholders are willing to participate in. NMED may also utilize focus groups comprised of various stakeholders to gather feedback on possible emission reduction activities. All these concerns will be taken into consideration as we assess our Ozone Advance plan in the future.

NMED understands that some people may not have the time or means to attend these meetings. To this end, NMED will also provide an opportunity for these groups and individuals to submit concerns and comments electronically, over the phone, or by mail. NMED may also provide surveys and other useful materials for stakeholders to complete.

Ozone Community Workshops and Voluntary Ozone Alert Programs

Community involvement in the Ozone Advance program will include workshops and voluntary ozone alert programs. The workshops will bring together community members and various stakeholders to learn about ozone and its impacts to their health, community, and the environment. This will also include training on how to minimize these impacts, particularly health impacts, during high ozone events and what voluntary actions individuals can do to minimize their ozone contribution.

If communities choose to, they can opt to creating a Voluntary Ozone Alert Program, crafted to the needs of their community. This program can include a variety of activities and projects such as, community-based air monitoring, flag programs, alert programs, and air quality training. These programs will also raise awareness for issues surrounding ozone in these communities.