U.S. Department of the Interior
Bureau of Land Management

Carlsbad Field Office January 2021 Competitive Oil and Gas Lease Sale
Supplemental Analysis
Eddy and Lea Counties, New Mexico
April 2024
DOI-BLM-NM-P020-2020-1128-EA

U.S. Department of the Interior
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LIST OF ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
μg/m^3	micrograms per cubic meter
AirToxScreen	Air Toxics Screening Assessment
APD	Application for Permit to Drill
AQRV	air quality–related value
b/d	barrels per day
Bcf/d	billion cubic feet per day
BLM	Bureau of Land Management
BMP	best management practice
CAA	Clean Air Act
CAM_X	Comprehensive Air Quality Model with extensions
CAP	criteria air pollutant
CEQ	Council on Environmental Quality
CFO	Carlsbad Field Office
C.F.R.	Code of Federal Regulations
CH_4	methane
CMAQ	Community Multiscale Air Quality Modeling System
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COA	condition of approval
EA	environmental assessment
EIA	U.S. Energy Information Administration
EMNRD	Energy, Minerals, and Natural Resources Department
EOR	estimated occupied range
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
EUR	estimated ultimate recovery
GHG	greenhouse gas
GWP	global warming potential
HAP	hazardous air pollutant
HI	hazard index
HQ	hazard quotient
IMPROVE	Interagency Monitoring of Protected Visual Environments
IPCC	Intergovernmental Panel on Climate Change

IRA	Inflation Reduction Act of 2022
IWG	Interagency Working Group
kg N/ha	kilograms of nitrogen per hectare
kg S/ha	kilograms of sulfur per hectare
LEPC	lesser prairie-chicken
MAGICC	Model for the Assessment of Greenhouse Gas Induced Climate Change
mg/m^3	milligrams per cubic meter
MMst	million short tons
Mt	megatonne(s)
N/A	not applicable
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NATA	National Air Toxics Assessment
NEI	National Emissions Inventory
NEPA	National Environmental Policy Act
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NETL	National Energy Technology Laboratory
NMAAQS	New Mexico Ambient Air Quality Standards
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NO_2	nitrogen dioxide
NO_X	nitrogen oxide(s)
NPS	National Park Service
NSPS	New Source Performance Standards
O_3	ozone
OAI	Ozone Attainment Initiative
Pb	lead
PDO	Pecos District Office
$PM_{2.5}$	particulate matter equal to or less than 2.5 microns in diameter
PM_{10}	particulate matter equal to or less than 10 microns in diameter
ppb	parts per billion
ppm	parts per million
PSD	Prevention of Significant Degradation
RfC	reference concentration
RFD	reasonably foreseeable development
RFO	Roswell Field Office
RRF	relative response factor

SC-GHG	social cost of greenhouse gases
SO_2	sulfur dioxide
STEO	short-term energy outlook
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
WAQS	Western Air Quality Study
WRAP	Western Regional Air Partnership

CHAPTER 1. INTRODUCTION

1.1 BACKGROUND

On January 29, 2021, the Bureau of Land Management (BLM) issued a decision regarding the Carlsbad Field Office (CFO) January 2021 Competitive Oil and Gas Lease Sale (January 2021).[1] The decision was challenged in Citizens Caring for the Future v. Deb Haaland, Case No. 2:23-cv-60 (District of New Mexico) (Citizens Caring). The lawsuit is pending as to the parcels undergoing supplemental review.

This supplemental analysis (SA) to the CFO January 2021 environmental assessment (EA) (DOI-BLM-NM-P020-2020-1128-EA) is the result of the BLM's review of the subject National Environmental Policy Act (NEPA) analysis and provides information, data, and/or analyses that are: 1) new since work was completed on the final January 2021 EA, and 2) substantive and relevant to the BLM's informed decision making and public disclosure process. This supplemental analysis replaces the analysis of the same issues in the final January 2021 EA and accompanies the final EA and the associated, new finding of no significant impact (FONSI) and decision record (DR). This supplemental analysis, together with the analysis from the final January 2021 EA, constitutes the final NEPA documentation for the CFO January 2021 Competitive Oil and Gas Lease Sale.

Future potential development of the 32 lease parcels (5,942.36 acres) nominated for auction during the January 2021 Competitive Oil and Gas Lease Sale is estimated at approximately 32 horizontal wells and 144.00 acres of surface disturbance. Total oil, gas, and produced water production is estimated to be 5,376,000 barrels; 31,347,200 thousand cubic feet; and 18,604,800 barrels, respectively.

1.1.1 Purpose and Need

The BLM's purpose is to determine whether to maintain the leasing decision from the original EA or alter that decision by retracting, or cancelling, the leases which the BLM has already approved. The need for the action is established by the BLM's responsibility under the Mineral Leasing Act of 1920, as amended, to promote the exploration and development of oil and gas on the public domain consistent with the regulations prescribed by the Secretary of the Interior, where consistent with the Federal Land Policy and Management Act, NEPA, and other applicable laws, regulations, and policies.

1.1.2 Decision to Be Made

The BLM Authorized Officer will decide whether to affirm the previous decision to make available for lease the subject lease parcels with or without constraints, in the form of lease stipulations, as provided for in the approved land use plans. If the decision is to affirm the previous decision to make the lands available for lease, and affirm the issuance of a lease, standard terms and conditions under Section 6 of the BLM Lease Form (Form 3100-11, Offer to Lease and Lease for Oil and Gas), herein referred to as standard terms and conditions, would apply. The BLM Authorized Officer also has the authority to cancel previously leased parcels, based on the analysis of potential effects presented in this supplemental analysis. The decision record will identify whether the BLM decided to affirm its previous decision to lease the nominated lease parcels and the rationale for the decision.

[1] https://eplanning.blm.gov/public_projects/2000534/200380399/20038874/250045069/EA_CFO_Jan2021LeaseSale_Final_508.pdf

1.1.3 Proposed Action

Under the Proposed Action, the BLM would affirm its previous decision to offer and issue the subject leases. Any parcels that were leased previously would remain leased.

1.1.4 No Action Alternative

Under the No Action Alternative, the BLM would not affirm its previous decision to offer and issue the subject leases. Selection of the No Action Alternative would not prevent future leasing in these areas consistent with the relevant resource management plan.

1.2 ADDITIONAL PUBLIC INVOLVEMENT

This draft January 2021 Competitive Oil and Gas Lease Sale supplemental analysis will be made available for a public comment period from April 22 to May 20, 2024. All comments received will be reviewed and analyzed. Substantive comments will be extracted and addressed as appropriate.

CHAPTER 2. AFFECTED ENVIRONMENT AND ENVIRONMENTAL EFFECTS

2.1 ISSUES ANALYZED IN BRIEF

The BLM CFO final January 2021 Competitive Oil and Gas Lease Sale EA contains final analysis for 26 issues that were analyzed in brief. None of the 26 issues analyzed in brief in the BLM CFO final January 2021 Competitive Oil and Gas Lease Sale EA are being replaced by the analyses in this supplemental analysis; the January 2021 EA contains the latest analysis of those issues.

2.2 ISSUES ANALYZED IN DETAIL

Supplemental analysis of Issue 1 (Air Quality), and Issue 2 (Greenhouse Gases and Climate Change) are provided in Sections 2.2.1 and 2.2.2, respectively. These analyses completely replace the analyses that were prepared in Sections 3.5.1 and 3.5.2 of the BLM CFO final January 2021 Competitive Oil and Gas Lease Sale EA. Note that Issue 3 (Water Use and Quantity Analysis) and Issue 4 (Dunes Sagebrush Lizard and Lesser Prairie Chicken) in the BLM CFO final January 2021 Competitive Oil and Gas Lease Sale EA remain the latest analysis of those issues.

2.2.1 Issue 1: Air Quality

How would future potential development of the nominated lease parcels affect air quality (particularly National Ambient Air Quality Standards and volatile organic compounds) in the analysis area?

Air quality is determined by the quantity and chemistry of atmospheric pollutants in consideration of meteorological factors (i.e., weather patterns) and topography, both of which influence the dispersion and concentration of those pollutants. Air pollutants result from a number of different and widespread sources of emissions. The analysis area for this issue is the entirety of Lea and Eddy Counties, which is part of the New Mexico portion of the Permian Basin which includes Lea, Eddy, Roosevelt, and Chaves Counties. This spatial scope of analysis was identified based on the regional nature of air pollution and to facilitate analysis using the best available air quality data, which are generally provided at the county level. For the purposes of this analysis, short-term effects to air quality are considered those that cease after well construction and completion (30–60 days); long-term effects are considered those associated with operations and production and would cease after operations/production are concluded.

Much of the information in this section is incorporated from the *BLM 2022 Air Resources Technical Report for Oil and Gas Development in New Mexico, Oklahoma, Texas, and Kansas* (herein referred to as Air Resources Technical Report and incorporated into this EA by reference) (BLM 2023a).

2.2.1.1 *Affected Environment*

The Clean Air Act (CAA), 42 United States Code §§ 7401-7671(q), requires the U.S. Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. *Primary standards* provide public health protection, and *secondary standards* provide for public welfare, including protection against degraded visibility and damage to animals, crops, vegetation, and buildings (EPA 2024a). The primary NAAQS are required to be set at a level to protect public health, including the health of at-risk populations, with an adequate margin of safety in order to prevent known or anticipated health-related effects from polluted air.

The EPA has set NAAQS for six principal pollutants ("criteria" air pollutants): carbon monoxide (CO); nitrogen dioxide (NO_2); ozone (O_3); particulates (i.e., particulate matter equal to or less than 10 microns in diameter [PM_{10}] and particulate matter equal to or less than 2.5 microns in diameter [$PM_{2.5}$]); sulfur dioxide (SO_2); and lead (Pb) (EPA 2024a). The EPA has delegated the responsibility of regulation and enforcement of the NAAQS to the state level and has approved the New Mexico State Implementation Plan, which allows the State to enforce both the New Mexico Ambient Air Quality Standards (NMAAQS) and the NAAQS on all public and private lands with the exception of tribal lands and lands within Bernalillo County (BLM 2023a).[2] The New Mexico Environment Department (NMED) Air Quality Bureau is responsible for implementation of the State Implementation Plan and enforcement of air quality standards (BLM 2023a). A detailed description of these pollutants, along with their health effects and their sources, can be found in Chapter 3 of the Air Resources Technical Report (BLM 2023a) and has been incorporated by reference.

CRITERIA POLLUTANT CONCENTRATIONS

Concentrations of air pollutants are measured at air monitoring sites and expressed in parts per million (ppm), parts per billion (ppb), or micrograms per cubic meter (μg/m^3), depending on the unit of measure for a specific standard. The EPA and State of New Mexico periodically analyze and review air monitor locations and will discontinue monitoring where pollutant concentrations have been well below standards or may add monitors in areas where concentrations may be suspected of approaching the NAAQS or the NMAAQS (BLM 2023a).

Design values are the concentrations of air pollution at a specific monitoring site that can be compared with the NAAQS. Compliance with the NAAQS is typically demonstrated through monitoring of ground-level concentrations of atmospheric air pollutants. Areas where pollutant concentrations are below the NAAQS are designated as attainment or unclassifiable. Locations where monitored pollutant concentrations are higher than the NAAQS are designated nonattainment, and air quality is considered unhealthy (BLM 2023a). The most recent design values for criteria pollutants within Lea and Eddy

[2] Under the CAA and the Tribal Authority Rule, tribes have express authority to manage air quality on tribal lands. Air quality in Bernalillo County is regulated by the City of Albuquerque/Bernalillo Air Quality Division.

Counties are listed in Table 2-1 and are incorporated by reference from the Air Resources Technical Report (BLM 2023a). These counties do not have monitoring data for CO, Pb, or PM_{10} concentrations, but because the counties are relatively rural, it is likely that these pollutants are not elevated.
The Proposed Action is located in an area that is classified as attainment/unclassified for each of the NAAQS; however, air monitoring data shows that 8-hour O_3 design values in the Proposed Action area are within 95% of the 8-hour O_3 NAAQS and in some cases are above the NAAQS.

O_3 is the criteria pollutant that is of most concern for the analysis area. As stated above, 8-hour O_3 design values in the Proposed Action area are within 95% of the 8-hour O_3 NAAQS and in some cases are above the NAAQS. Pursuant to New Mexico Statute 74-2-5.3, if the NMED determines that emissions from sources within its jurisdiction cause or contribute to O_3 concentrations in excess of 95% of the NAAQS for O_3, it shall adopt a plan, including regulations, to control emissions of nitrogen oxides (NO_X) and volatile organic compounds (VOCs) to provide for attainment and maintenance of the standard.
The NMED initiated an Ozone Attainment Initiative (OAI) to address O_3 levels in the area, including recent new rulemaking (Waste Prevention Rule [New Mexico Administrative Code {NMAC} 19.15.27.9] and O_3 Precursor Rule [NMAC 20.2.50.1; NMED 2023a, 2023b]). As a secondary pollutant, O_3 is not a direct emission pollutant (that is, it is not emitted directly into the air), but it is the result of chemical reactions between a group of highly reactive gases called NO_X and VOCs (which are organic compounds that vaporize [i.e., become a gas] at room temperature) when exposed to sunlight (EPA 2024b). O_3 and NO_2 are criteria air pollutants (CAPs) and are regulated under the NAAQS and NMAAQS. VOCs are not criteria pollutants; however, because O_3 is not a direct emission, emissions of NO_X (particularly NO_2, which is used as an indicator for the larger group of gases) and VOCs are used as a proxy for determining potential levels of secondary formation of O_3.

Table 2-1. 2022 Design Values for Eddy and Lea Counties

Pollutant	2022 Design Values	Averaging Time	NAAQS	NMAAQS
O_3	0.077 ppm (Eddy County - Holland Street 350151005), 0.077 ppm (Eddy County - Carlsbad Caverns Highway 350150010), 0.066 ppm (Lea County)	8-hour	0.070 ppm†	–
NO_2	5 ppb (Eddy County), 4 ppb (Lea County)	Annual	53 ppb‡	50 ppb
NO_2	31 ppb (Eddy County), 31 ppb (Lea County)	1-hour	100 ppb§	–
$PM_{2.5}$*	6.3 μg/m^3 (Lea County)	Annual	9.0 μg/m^3 *	–
$PM_{2.5}$*	19.0 μg/m^3 (Lea County)	24-hour	35.0 μg/m^3 §	–

Source: Air Resources Technical Report (BLM 2023a).

Notes: The NMAAQS standard for total suspended particulates, which was used as a comparison for PM_{10} and $PM_{2.5}$, was repealed as of November 30, 2018. Where no standards are presented, the NAAQS still apply.

* Annual mean, averaged over 3 years.

† Annual fourth-highest daily maximum 8-hour concentration averaged over 3 years.

‡ Not to be exceeded during the year.

§ 98th percentile, averaged over 3 years.

O_3 is most likely to reach unhealthy levels on hot, sunny days in urban environments and can be transported long distances by wind into rural areas (EPA 2024b). People most at risk from breathing air containing O_3 include people with asthma, children, older adults, and people who are active outdoors, especially outdoor workers. In addition, people with certain genetic characteristics, and people with reduced intake of certain nutrients, such as vitamins C and E, are at greater risk from O_3 exposure (EPA 2024b). The largest sources of both NO_X and VOCs emissions in Eddy and Lea Counties include oil and gas sources, point sources, and on-road and non-road mobile sources (incorporated by reference from Section 4 of the Air Resources Technical Report [BLM 2023a]). Biogenic sources, such as vegetation and soil, can also represent a substantial portion of NO_X and VOC emissions, including Eddy and Lea Counties (BLM 2023a). Additional information on O_3, along with its health effects and sources, can be found in Section 3 of the Air Resources Technical Report (BLM 2023a), incorporated by reference.

Specifically, the 2811 Holland Street, 727 Carlsbad Caverns Highway and Carlsbad Caverns Np - Maintenance Area monitoring stations in Eddy County are analyzed in depth below (EPA 2023a). Table 2-2 and Table 2-3 provide the available 8-hour O_3 values from the three Eddy County monitoring stations, including the number of days per year any exceedances of the NAAQS occurred. Compliance with the NAAQS is typically demonstrated through monitoring of ground-level concentrations of atmospheric air pollutants. Current design values in Eddy County are above the 70 ppb 2015 O_3 NAAQS; however, the area is still designated as attainment. While the EPA is currently considering a designation, it has not made public any action to designate the area as nonattainment for O_3. Design value data and trends for the Proposed Action are found in the Air Resources Technical Report (BLM 2023a) and incorporated into this EA by reference.

NMED is required by New Mexico state statute, New Mexico Statutes Annotated 1978, § 74-2-5(C), to plan for O_3 mitigation in areas where monitors indicate O_3 levels are within 95% of the federal O_3 standard. Section 74-2-5(C) also authorizes the state's OAI and encompasses three main goals (NMED 2023a):

- To ensure the health and welfare of current residents and future generations in New Mexico.
- To protect the attainment/unclassifiable status of all areas in the state.
- To develop plans that detail how nonattainment areas will attain and maintain the standards by reducing O_3.

Table 2-2. O_3 Exceedances at the Eddy County Holland Site

Year	O_3 8-hour ppm*				
	Days with Exceedances	Highest	2nd Highest	3rd Highest	4th Highest
2016	0	0.065	0.064	0.064	0.063
2017	10	0.082	0.078	0.077	0.076
2018	18	0.096	0.095	0.091	0.083
2019	19	0.095	0.092	0.084	0.080
2020	5	0.075	0.075	0.075	0.073
2021	23	0.092	0.082	0.080	0.080
2022	23	0.084	0.083	0.080	0.079

Source: EPA (2023a).

Note: Values are from the Eddy County Holland Site: 2811 Holland Street, Carlsbad, New Mexico (ID 350151005).

* Annual fourth-highest daily maximum 8-hour concentration averaged over 3 years.

Table 2-3. O_3 Exceedances at the Eddy County Carlsbad Sites

Year	O_3 8-hour ppm*				
	Days with Exceedances	Highest	2nd Highest	3rd Highest	4th Highest
2016	0†	0.070	0.069	0.069	0.069
2017	0†	0.069	0.065	0.065	0.065
2018	10†	0.099	0.081	0.080	0.080
2019	6‡	0.082	0.080	0.078	0.074
2020	9‡	0.074	0.074	0.073	0.072
2021	15‡	0.085	0.080	0.079	0.077
2022	21‡	0.086	0.085	0.084	0.083

Source: EPA (2023a).

Note: Values are from the Eddy County Carlsbad Sites: 727 Carlsbad Caverns Highway, Carlsbad, New Mexico (ID 35010010) and Carlsbad Caverns Np - Maintenance Area (350153001).

* Annual fourth-highest daily maximum 8-hour concentration averaged over 3 years.

† Carlsbad Caverns Np - Maintenance Area (350153001) data.

‡ Carlsbad Caverns Highway (ID 35010010) data.

To address NO_X and VOC emissions, the NMED developed the "Oil and Natural Gas Regulation for Ozone Precursors," NMAC 20.2.50.1, which was published on July 26, 2022, with an effective date of August 5, 2022. Approximately 50,000 wells and associated equipment will be subject to this regulation. It is anticipated that the regulation will annually reduce VOC emissions by 106,420 tons, NO_X emissions by 23,148 tons, and methane (CH_4) emissions by 200,000 to 425,000 tons statewide. The regulation includes emissions reduction requirements for compressors, engines and turbines, liquids unloading, dehydrators, heaters, pneumatics, storage tanks, and pipeline inspection gauge launching and receiving. The regulation also encourages operators to stop venting and flaring and use fuel cells technology to convert CH_4 to electricity at the well site and incentivizes new technology for leak detection and repair.

The NMED also participates in the voluntary Ozone Advance Program, which is a collaborative effort to encourage O_3 emission reductions in attainment areas. Through this program, states, tribes, and local governments work with EPA to take near-term steps to improve local air quality and ensure continued health protection over the long term. The goal is to avoid NAAQS violations and maintain an attainment designation. Since New Mexico began participating in the Ozone Advance Program in April 2019, O_3 levels in Rio Arriba, Sandoval, Santa Fe, and Valencia Counties either currently or recently have exceeded 95% of the 2015 8-hour O_3 NAAQS (67 ppb) and could soon violate this standard. In total, the Ozone Advance Program and outreach efforts include the following nine counties: Chaves, Doña Ana, Eddy, Lea, Rio Arriba, San Juan, Santa Fe, Sandoval, and Valencia.

Another pollutant of concern in the southwestern United States is particulate matter. The EPA regulates particulate matter 10 micrometers in diameter or smaller (PM_{10} and $PM_{2.5}$) because these smaller particles are associated with negative health effects, including respiratory and cardiovascular problems, and because they can become more deeply imbedded into the lungs and may even get into the bloodstream (EPA 2023b) but does not regulate particles larger than 10 micrometers in diameter (such as sand and larger dust particles). As shown in Table 2-1, particulate matter $PM_{2.5}$ in the analysis area is not currently exceeding the NAAQS, including the new $PM_{2.5}$ annual NAAQS, as indicated by monitoring in Lea County. PM_{10} is not currently monitored in the analysis area, and no areas of high concentrations would warrant monitoring by NMED. Like O_3, particulate matter is formed by reactions between other chemicals, specifically between SO_2 and NO_X, which are emitted from vehicles, power plants, and other industrial processes (EPA 2023b). Additionally, particulate matter emissions often result directly from activities like construction, traffic on unpaved roads, fields, and fires (EPA 2023b). Additional information on particulate matter, along with its health effects and sources, can be found in Section 3 of the Air Resources Technical Report (BLM 2023a), incorporated by reference.

CRITERIA POLLUTANT EMISSIONS

Along with criteria pollutant concentrations as measured by air monitors, the EPA provides data on criteria pollutant emissions, expressed in tons per year or total volume of pollutant released into the atmosphere. Emissions data point to which industries and/or practices are contributing the most to the general level of pollution (BLM 2023a). State, basin, and county total emissions for all sources are reported in Table 2-4, based on the 2020 National Emissions Inventory (NEI) in tons per year. NEI data have been incorporated by reference from Section 4 of the Air Resources Technical Report (BLM 2023a).

The primary sources of air pollution in the analysis area are oil and gas sources, natural sources (biogenics), point sources, and on-road/non-road sources. In New Mexico, the largest sources of CAPs emitted by human activities are area sources for PM_{10} and $PM_{2.5}$, on-road sources for CO, and oil and gas sources for VOCs, SO_2, and NO_X. In the Permian Basin, the largest sources of CAPs emitted by human activities are area sources for PM_{10} and $PM_{2.5}$, point sources for SO_2, and oil and gas sources for CO, VOCs, and NO_X (BLM 2023a). The largest sources in individual counties may vary from state total emissions. Additional 2020 NEI data can be found in Section 4 of the Air Resources Technical Report (BLM 2023a), incorporated by reference.

Table 2-4. 2020 Air Pollutant Emissions, in Tons per Year

Source	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	VOCs	HAPs
State of New Mexico Total Emissions	129,132	42,623	199,462	87,828	615,513	712,639	105,524
Eddy and Lea County, New Mexico Total Emissions	13,570	4,600	59,510	82,081	91,287	227,325	25,271
Eddy County, New Mexico Total Emissions	7,325	2,305	26,808	35,502	45,159	101,008	11,764
Lea County, New Mexico Total Emissions	6,245	2,295	32,702	46,579	46,128	126,317	13,507

Source: BLM (2023a)

Note: BLM reports both biogenic and human-caused emissions in the table above.

HAPs = hazardous air pollutants

HAZARDOUS AIR POLLUTANTS

The CAA requires control measures for hazardous air pollutants (HAPs). A pollutant is classified as a HAP if it has been identified by the EPA as a compound that is known or suspected to cause cancer or other serious health effects, such as compromises to immune and reproductive systems, birth defects, developmental disorders, and/or adverse environmental effects (BLM 2023a). There are currently 187 compounds listed as HAPs by the EPA. National Emission Standards for HAPs (NESHAPs), established by the EPA, limit the release of specified HAPs from specific industries (40 Code of Federal Regulations [C.F.R.] §§ 61, 63). NESHAPs for oil and gas development include control of benzene, toluene, ethyl benzene, mixed xylenes, and n-hexane from major sources, and benzene emissions from triethylene glycol dehydration units as area sources (BLM 2023a).

The Air Resources Technical Report discusses the relevance of HAPs to oil and gas development and the particular HAPs that are regulated in relation to these activities (BLM 2023a) and has been incorporated by reference. Potential health risks associated with HAPs released into the air from oil and gas operations have been evaluated by review of existing emissions data, air quality monitoring, and modeling studies. The Air Resources Technical Report discusses in detail a 2019 health assessment study for which scientists from Colorado State University conducted on-site air monitoring for 47 VOCs (including HAPs) during various stages of well development and production at oil and gas extraction facilities in Colorado. In summary, simulated cancer risks to average individuals were below one in 1 million at distances of 1,400 feet from the well pads, four in 1 million at 500 feet from the well pads, and 10 in 1 million at 300 feet from the well pads. Fewer than one in 1 million people at distances of 2,000 feet from the well pads experienced the worst potential long-term combination of individual risk factors, oil and gas emissions, and local meteorological conditions (maximum exposed individual). This figure rises to seven in 1 million at 500 feet from the well pads, and 10 in 1 million at 400 feet from the well pads (BLM 2023a).

The Air Toxics Screening Assessment (AirToxScreen), published by the EPA, provides a screening tool for state, local, and tribal air agencies (EPA 2022a). The EPA's AirToxScreen is used to evaluate impacts from existing HAP emissions in New Mexico. AirToxScreen is the successor to the previous National Air Toxics Assessment (NATA). In December 2022, EPA released the results of its 2019 AirToxScreen (EPA 2022a). AirToxScreen calculates concentration and risk estimates from a single year's emissions data using meteorological data for that same year. The risk estimates assume a person breathes these emissions each year over a lifetime (or approximately 70 years). AirToxScreen provides quantitative estimates of potential cancer risk and five classes of non-cancer hazards (grouped by organ/system: immunological, kidney, liver, neurological, and respiratory) associated with chronic inhalation exposure to real-world toxics for each county and census tract (BLM 2023a). AirToxScreen is a cumulative HAP assessment based on total HAP emissions from all sources contained in the NEI. Per the AirToxScreen Technical Support Document (EPA 2022b), this national-scale assessment (AirToxScreen) is consistent with EPA's definition of a cumulative risk assessment, as stated in EPA's *Framework for Cumulative Risk Assessment*, as "an analysis, characterization, and possible quantification of the combined risks to health or the environment from multiple agents or stressors" (EPA 2003:6). A review of the results of the 2019 AirToxScreen shows that cancer risks, neurological risks, and respiratory risks in the analysis area are all lower than national levels and are generally the same as the state of New Mexico.

The 2019 AirToxScreen analysis reveals that the total cancer risk (defined as the probability of contracting cancer over the course of a 70-year lifetime, assuming continuous exposure) in Lea and Eddy Counties is 20.2 and 22.3 in 1 million people, respectively, which is lower than the nationwide level (25.5 in 1 million) and in the same range as the state of New Mexico (19.1 in 1 million). The contribution of the oil and gas industry to the cancer risk in Lea and Eddy Counties is 3.0 and 3.9 cases in 1 million, respectively (EPA 2022a).[3] Bright lines[4] could not be used in the analysis of the HAP results to determine if a particular risk level is acceptable or not, as no such construct for risk exists within the CAA framework akin to the NAAQS (that is, there are no NAAQS against which to compare modeled HAP concentrations). Rather, values or ranges of values published by EPA (e.g., AirToxScreen [NATA] or 40 C.F.R. § 300.430 [Remedial Investigation/Feasibility Study]) were used to provide useful context to risk estimates. While no explicit risk thresholds are available, EPA uses one in 1 million and 100 in

[3] A one in 1 million lifetime cancer risk is defined as for every 1 million people who are continuously exposed over 70 years to a certain level of a pollutant, one person may develop cancer (EPA 2022a).

[4] "A "bright line" in risk characterization refers to a threshold value that separates acceptable and unacceptable levels of risk. It is regarded as a clear and unambiguous limit used to determine whether a particular level of exposure to a hazardous substance is safe or not." (BLM 2024a:6).

1 million risk for context (EPA 2022b). As a result, the values for Lea and Eddy Counties are within the contextual range published by the EPA.

AirToxScreen non-cancer hazards (i.e., respiratory) are expressed as a ratio of an exposure concentration to a reference concentration (RfC). RfCs are indicators defined by the EPA as the daily inhalation concentrations at which no long-term adverse health impacts are expected. For a given air toxin, exposures at or below the RfC (i.e., hazard quotients [HQs] 1 or less) are not likely to be associated with adverse health effects. As exposures increase above the RfC (i.e., HQ greater than 1), the potential for significant adverse effects also increases (BLM 2023b). Chronic non-cancer hazards are estimated for multiple air toxics by summing the HQs, creating a hazard index (HI). The respiratory HI in the analysis area (Lea and Eddy Counties) ranges from 0.21 and 0.23, respectively, which is lower than the national HI (0.31) and within a similar range as the New Mexico HI (0.22) (BLM 2023a). Additional AirToxScreen data can be found in Section 5 of the Air Resources Technical Report (BLM 2023a), incorporated by reference.

This HAPs analysis was prepared in response to an adverse decision of the Tenth Circuit. While the U.S. Court of Appeals for the Tenth Circuit directed the BLM to analyze cumulative HAPs emissions for the San Juan Basin in its oil and gas leasing under NEPA (Diné Citizens Against Ruining Our Env't v. Haaland, 59 F.4th 1016, 1047 (10th Cir. 2023) ("*Diné CARE II* "),[5] the BLM has also created the same analysis for the CFO. The BLM Cumulative Hazardous Air Pollutants Modeling – Final Report (Ramboll and BLM 2023) and the BLM Summary of Cumulative Oil and Gas Hazardous Air Pollutant Analysis for the Pecos District Office (PDO) (Appendix A), incorporated by reference and summarized below, detail the modeling methods used and the results of the modeling. Note, while Appendix A shows the analysis for all of the PDO, only the counties in the Carlsbad Field Office were discussed in this EA.

The BLM's Western United States HAP photochemical modeling assessment was prepared to support BLM's analysis of cumulative oil and gas impacts from HAPs originating from oil and gas production in Colorado, Montana, New Mexico, North Dakota, South Dakota, Utah, and Wyoming (states where the BLM commonly authorizes federal activities for fossil energy development) on public health. In regard to which HAPs to consider in the analysis, the *Diné CARE II* Court specifically mentioned five HAPs—benzene, toluene, ethylbenzene, mixed xylenes, and n-hexane—as applying to oil and gas development activities based on the National Emission Standards for HAPs (NESHAPs, see 43 C.F.R. § 63.
The modeling assessment evaluated emissions from existing federal, new federal, and non-federal oil and gas sources and includes six key HAPs—benzene, toluene, ethylbenzene, xylene, n-hexane, and formaldehyde—because these compounds are common in the oil and gas sector and consistent with regulatory requirements described in the EPA's New Source Performance Standards (NSPS), see 43 C.F.R. § 60, and NESHAPs. HAP emissions in this study include emission sources associated with wellsite exploration, wellsite production, and midstream sources (Ramboll and BLM 2023).
The modeling analysis evaluated air quality out to a future year of 2032[6] utilizing data from the 2028 Western Regional Air Partnership (WRAP)/Western Air Quality Study (WAQS) modeling platform, the EPA SPECIATE 5.14 speciation profiles, the EPA's 2016v2 emissions modeling platform (EPA 2022c), and the BLM oil and gas development projections to quantify and apportion federal and non-federal oil and gas emissions (Ramboll and BLM 2023). The model output allows the BLM to compare concentrations of HAPs to calculated risk-based thresholds in order to provide the hard look at the effects on public health required by NEPA.

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[5] The federal Clean Air Act defines a hazardous air pollutant (HAP) as "any air pollutant" of which "emissions, ambient concentrations, bioaccumulation or deposition of the substance are known to cause or may reasonably be anticipated to cause adverse effects to human health or adverse environmental effect." 42 U.S.C. § 7412.

[6] EPA's 2016v2 modeling platform (EPA 2022c), the most advanced dataset at the time of model development, includes emissions for the years 2016, 2023, 2026, and 2032. Future year 2032 was used in this modeling assessment.

Carcinogenic and noncarcinogenic chronic risks from modeled oil and gas concentrations were calculated for future year 2032. The emissions inventory for the CFO was based on Annual Energy Outlook oil and gas projections for the Permian Basin. These projections describe the reasonably foreseeable oil and gas development anticipated to occur within the Permian Basin projected out to 2032, providing the temporal component of the cumulative oil and gas analysis as described by the Council on Environmental Quality (CEQ) regulations. These projections reflect the best currently available information for projected oil and gas development in the Permian Basin. Health-based inhalation thresholds and cancer unit risk estimate threshold values were obtained from the weight of evidence for carcinogenicity under the 2005 EPA cancer guidelines (without revisions) (EPA 2021; 2022d). A residency exposure adjustment factor was applied to the cancer inhalation risk by multiplying the annual modeled concentration by the cancer unit risk factor and multiplying this product by an applicable exposure adjustment factor. The residency exposure adjustment factor[7] is computed by taking the average residency of the county where development is proposed (Table 2-5) and dividing that by the length of exposure over an assumed 70-year life span. For example, for Eddy County, the residency exposure adjustment factor would be 15.0/70. All other values in Table 2-5 through Table 2-7 are raw model outputs with no adjustment applied.

Table 2-5. County-Specific Residency Information

Area	Chaves County, New Mexico	Eddy County, New Mexico	Lea County, New Mexico	New Mexico	United States
Years	14.9	15.0	14.0	13.1	12.4

Source: U.S. Census Bureau (2022).

Table 2-6 shows the oil and gas cancer risk from federal sources (existing and new) and from all mineral designations together from the combination of benzene, ethylbenzene, and formaldehyde. The risk analysis was only performed for three HAPs (benzene, ethylbenzene, and formaldehyde) because these pollutants had EPA-provided non-zero unit risk estimate values based on the weight of evidence approach (EPA 2021). The non-adjusted (70-year) cancer risk from all oil and gas sources for Chaves, Eddy, and Lea Counties is less than 20 in a million (maximum of 15.10 in Eddy County). The maximum total oil and gas residency exposure-adjusted cancer risk for Chaves, Eddy, and Lea Counties, as described above, is 1.59, 3.24, and 2.62, respectively.

Table 2-6. Estimated Cancer Risk from 2032 Oil and Gas Production in the Carlsbad Field Office by Mineral Designation

County	Cancer Risk* from Existing Federal Wells (per million)	Cancer Risk* from New Federal Wells (per million)	Cancer Risk* from Total Federal Wells (per million)	Cancer Risk* from Non-Federal Wells (per million)	Cancer Risk* from Cumulative Oil and Gas Production (per million)	Adjusted Cancer Risk† From Cumulative Oil and Gas Production (per million)
Chaves	0.20 to 2.51	0.07 to 1.54	0.26 to 3.95	0.20 to 3.53	0.46 to 7.48	0.10 to 1.59
Eddy	0.20 to 6.91	0.08 to 2.95	0.28 to 7.57	0.22 to 8.95	0.51 to 15.10	0.11 to 3.24
Lea	0.45 to 4.65	0.25 to 4.86	0.72 to 7.10	0.79 to 6.46	1.61 to 13.11	0.32 to 2.62

*Cancer risk from emissions of benzene, ethylbenzene, and formaldehyde.

†Adjusted residency risk based on residency factors by county (14.9 years for Chaves, 15.0 years for Eddy, and 14.0 years for Lea Counties).

[7] EPA's Exposure Assessment Tools by Routes – Inhalation; https://www.epa.gov/expobox/exposure-assessment-tools-routes-inhalation.

Risk characterization is a description of the nature and, often, magnitude of human risk, including resulting uncertainties. Risk characterization is accomplished by integrating information from the components of the risk assessment and synthesizing an overall conclusion about risk that is complete, informative, and useful for decision makers (EPA 2000). A "bright line" in risk characterization refers to a threshold value that separates acceptable and unacceptable levels of risk. It is regarded as a clear and unambiguous limit used to determine whether a particular level of exposure to a hazardous substance is safe. Bright lines were not used in the analysis of the cumulative oil and gas HAPs results to determine if a particular risk level is acceptable or not, as no such construct for risk exists within the Clean Air Act framework akin to the NAAQS (that is, there are no NAAQS against which to compare modeled HAP concentrations). Rather, values or ranges of values published by EPA (e.g., AirToxScreen [NATA] or 40 C.F.R. § 300.430 [Remedial Investigation/Feasibility Study]) were used to provide useful context to risk estimates associated with the cumulative oil and gas HAPs study. As described in the BLM Cumulative Hazardous Air Pollutants Modeling - Final Report (Ramboll and BLM 2023), while no explicit risk thresholds are available, EPA uses a one in 1 million and 100 in 1 million risk for context (EPA 2022d). As a result, both the 70-year cancer risk and the adjusted cancer risk in Table 2-6 are within the contextual range published by the EPA. It is important to note that the cancer risks estimated by this assessment only consider cumulative oil and gas sources and six common oil and gas HAP pollutants. While the cumulative oil and gas contribution is within the contextual range published by EPA (one in 1 million and 100 in 1 million), additional HAPs from non-oil and gas sources could increase the overall risk in the project area. This modeling assessment looked at cumulative oil and gas sources to address the Court's holding in regard to analysis of cumulative HAP emissions. It was beyond the scope of this modeling assessment to determine cumulative HAP values from non-oil and gas sources.

AirToxScreen is consistent with EPA's definition of a cumulative risk assessment. The contribution, based on EPA's most recent AirToxScreen results (2019), of the oil and gas industry to the cancer risk in Chaves, Eddy, and Lea Counties ranged from 0.15 to 3.91 in a million (BLM 2023a). While not paired in time, the BLM's cumulative oil and gas study showed the contribution of the oil and gas industry to cancer risk (circa 2032) in Chaves, Eddy, and Lea Counties ranged from 1.59 to 3.24 in a million (Appendix A). While different methods were used by EPA and the BLM to determine cumulative oil and gas contributions and this could result in inconsistencies when comparing the data, the overall trend projects cumulative oil and gas contribution will be steady to slightly decreasing between 2019 and circa 2032. The overall HAPs trend could be further affected by projected declines in other sectors based on increased electrification, equipment efficiency, and renewable technologies for electricity generation (U.S. Energy Information Administration [EIA] 2023a). To have an entirely consistent analysis between BLM and EPA would have required BLM to project the entire NEI forward to a common future year (2032 in the BLM study) and use the Community Multiscale Air Quality Modeling System (CMAQ) model with the unique chemical mechanism within CMAQ used in AirToxScreen. To BLM's knowledge, in the near 30-year history of EPA's NATA, of which AirToxScreen is part of, a future year projection for NATA has never been attempted and such an exercise would be outside the scope of this EA and would not contribute to informed decision-making for the proposed action. Therefore, using the AirToxScreen results described above, if one were to simply add the risk values for the respective counties between EPA's and BLM's modeling (would not be scientifically valid given the varying methodologies), the addition of the other source categories places the total risk from other sources, in addition to future projections of HAPs impacts from oil and gas development, still well within the one in 1 million and 100 in 1 million risk range.

Table 2-7 shows the HQs for each compound and the HI. EPA estimates chronic non-cancer HQs by dividing a chemical's estimated long-term exposure concentration by the RfC for that chemical. Chronic non-cancer hazards from multiple air toxics were assessed by calculating an HI through the summation of individual HAP HQs that share similar adverse health effects, resulting in a target organ–specific HI representing the risk to a specific organ or organ system. An HQ or HI value less than 1 indicates that the

exposure is not likely to result in adverse non-cancer effects (Ramboll and BLM 2023, EPA 2022c). Chaves, Eddy, and Lea Counties show HQ and HI values below 1 for all mineral designations, indicating that cumulative oil and gas source exposure is not likely to result in adverse non-cancer effects.
The maximum HI from total oil and gas production is also below 1, at 0.0564, 0.1145, and 0.1007, for Chaves, Eddy, and Lea Counties, respectively. It is important to note that the non-cancer risks estimated by this assessment only consider cumulative oil and gas sources and the six common oil and gas pollutants. While the cumulative oil and gas contribution are below 1, additional HAPs from non-oil and gas sources could increase the overall risks in the project area. This modeling assessment looked at cumulative oil and gas sources to address the Court's holding in regard to analysis of cumulative HAP emissions. It was beyond the scope of this modeling assessment to determine cumulative HAP values from non-oil and gas sources.

Table 2-7. Estimated Hazard Quotients and Hazard Index from Circa 2032 Oil and Gas Production in the Carlsbad Field Office by Mineral Designation

	Hazard Quotient						Hazard Index
Source	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylene**	**n-Hexane**	**Formaldehyde**	
Chaves County							
Existing federal	<0.0001 to 0.0008	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0001	Range is <0.0001	0.0015 to 0.0181	0.0015 to 0.0191
New federal	<0.0001 to 0.0019	Range is <0.0001	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0004	0.0005 to 0.0085	0.0005 to 0.0109
Total federal	<0.0001 to 0.0026	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0002	<0.0001 to 0.0004	0.0019 to 0.0263	0.002 to 0.0294
Non- federal	<0.0001 to 0.0017	Range is <0.0001	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0004	0.0015 to 0.0259	0.0015 to 0.027
Total	*0.0001 to 0.0034*	*Range is <0.0001*	*Range is <0.0001*	*<0.0001 to 0.0003*	*<0.0001 to 0.0005*	*0.0034 to 0.0522*	*0.0035 to 0.0564*
Eddy County							
Existing federal	<0.0001 to 0.0039	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0004	<0.0001 to 0.0006	0.0015 to 0.047	0.0016 to 0.0516
New federal	<0.0001 to 0.0037	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0001	<0.0001 to 0.0008	0.0005 to 0.0162	0.0006 to 0.0208
Total federal	<0.0001 to 0.0052	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0005	<0.0001 to 0.0008	0.0021 to 0.0528	0.0021 to 0.0563
Non- federal	<0.0001 to 0.0043	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0004	<0.0001 to 0.0008	0.0017 to 0.0632	0.0017 to 0.0679
Total	*0.0001 to 0.0069*	*Range is <0.0001*	*Range is <0.0001*	*<0.0001 to 0.0007*	*<0.0001 to 0.0009*	*0.0037 to 0.1066*	*0.0039 to 0.1145*
Lea County							
Existing federal	0.0001 to 0.0014	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0002	<0.0001 to 0.0002	0.0033 to 0.0353	0.0034 to 0.0361
New federal	0.0002 to 0.012	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0002	<0.0001 to 0.0029	0.0015 to 0.0156	0.0018 to 0.0309
Total federal	0.0004 to 0.0127	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0003	<0.0001 to 0.003	0.0049 to 0.0491	0.0054 to 0.0511
Non- federal	0.0003 to 0.0016	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0002	<0.0001 to 0.0003	0.0057 to 0.0477	0.006 to 0.0496
Total	*0.0008 to 0.0133*	*Range is <0.0001*	*Range is <0.0001*	*<0.0001 to 0.0003*	*<0.0001 to 0.003*	*0.0111 to 0.0968*	*0.0121 to 0.1007*

AIR QUALITY RELATED VALUES

Prevention of Significant Deterioration (PSD) is a CAA permitting program for new or modified major sources of air pollution located in attainment areas. It is designed to prevent NAAQS violations, preserve and protect air quality in sensitive areas, and protect public health and welfare (EPA 2023c). Under PSD regulations, the EPA classifies airsheds as Class I, Class II, or Class III. The CAA PSD requirements give more stringent air quality and visibility protection to national parks and wilderness areas that are designated as Class I areas, but a PSD designation does not prevent emission increases. Federal land managers are responsible for defining specific air quality–related values (AQRVs), including visual air quality (haze) and acid (nitrogen and sulfur) deposition, for an area and for establishing the criteria to determine an adverse impact on the AQRVs. The nearest Class I areas are Carlsbad Cavern National Park and Guadalupe Mountains National Park to the west, Salt Creek Wilderness to the north, and the White Mountain Wilderness to the northwest. The analysis area is in attainment for the NAAQS and the NMAAQS and is categorized as a Class II area except for the Class I Carlsbad Cavern National Park area located in Eddy County (BLM 2023a). This project is not subject to PSD analysis or permitting.

Visibility trends based on air monitoring data from the Interagency Monitoring of Protected Visual Environments (IMPROVE) monitors in the BLM New Mexico area of responsibility show that visibility trends have been flat or improving (Figures 9 through 20 of the Air Resources Technical Report [BLM 2023a]). Specifically, visibility trends shown for Carlsbad Cavern/Guadalupe Mountains National Park, Salt Creek Wilderness, and White Mountain Wilderness indicate that visibility on the best days has been flat to improving and that visibility on worst days has shown a flat to a slight improvement over the period of record, although the annual variability makes determining a trend difficult over the period of record. Implementation of Best Available Retrofit Technology strategies as required under the federal Regional Haze Rule, over the next few years should result in further improvements (BLM 2023a).

The National Park Service (NPS) monitors and evaluates deposition to determine which parks are most at risk from air pollution and where conditions are declining or improving. Nitrogen deposition conditions in NPS-managed areas near the project area are generally poor to good, with no trend available, while sulfur deposition conditions are poor to good, with no trend or a relatively unchanging trend (where trend data is available) (BLM 2023a).

AIR QUALITY DESIGN CONSIDERATIONS

Various federal and state-level permitting programs ensure protectiveness of the NAAQS and reduce effects to AQRVs at Class I areas. New major emitting facilities or significant modifications to major emitting facilities are required to undergo PSD preconstruction review. PSD review requires an air quality analysis to assess the project's potential contribution to the NAAQS and PSD increments (maximum allowable increases in air quality over baseline concentrations), a Best Available Control Technology Analysis, and an additional effects analysis (to assess potential effects to soils, vegetation, and visibility) (EPA 2023d). Complete PSD applications are generally forwarded to the NPS Air Quality Division for review to ensure protectiveness of AQRVs at Class I areas.

Additional state-level permitting requirements have been adopted by NMED, such as New Source Review permitting requirements or de minimis emission thresholds (10 pounds per hour or 25 tons per year of any criteria pollutant) that must be met in lieu of completing the construction permitting process; these are also enforced within the analysis area to ensure protectiveness of the NAAQS (NMED 2023c). Construction permitting requirements are listed in NMAC 20.2.72. The Air Resources Technical Report (BLM 2023a) contains additional discussion on federal and state air quality rules and regulations and is incorporated by reference. At the Application for Permit to Drill (APD) stage, the BLM looks to minimize air pollutants via conditions of approval (COAs). Examples of additional air quality control measures imposed at the APD stage may include submission of an emissions inventory for the plan of development, air quality modeling, or implementation of mitigation measures and best management practices (BMPs). The BLM would do this in coordination with the EPA, NMED, and other agencies that have jurisdiction on air quality.

2.2.1.2 *Environmental Effects*

IMPACTS OF THE PROPOSED ACTION

Substantial air resource impacts are not anticipated from leasing as it is an administrative action. Any potential effects to air quality from the sale of lease parcels would occur at such time that any issued lease is developed and not at the leasing stage itself. The Proposed Action does not authorize or guarantee the number of wells analyzed herein. If leased, drilling of wells on a lease would not be permitted until the BLM approves an APD. Any APD received would be subject to site-specific NEPA review. However, development assumptions have been made in this EA to better inform the decision maker and the public of potential impacts to air quality if the lease is developed.

Four general phases of post-lease development would generate air pollutant emissions: 1) well development (well site construction, well drilling, and well completion), 2) well production operations (extraction, separation, gathering), 3) mid-stream (refining, processing, storage, and transport/distribution), and 4) end-use (combustion or other uses) of the fuels produced. While well development and production operation emissions (phases 1 and 2) occur on-lease and the BLM has program authority over these activities, mid-stream and end-use emissions (phases 3 and 4) typically occur off-lease where the BLM has no program authority.

During well development, there could be emissions from earth-moving equipment, vehicle traffic, drilling, and completion activities. NO_2, SO_2, and CO would be emitted from vehicle tailpipes. Fugitive dust concentrations would increase with additional vehicle traffic on unpaved roads and from wind erosion in areas of soil disturbance. Drill rig and fracturing engine operations would result mainly in NO_2 and CO emissions, with lesser amounts of SO_2. These temporary emissions would be short-term during the drilling and completion phases, which is expected to last between 30 and 60 days. During well production and operations there could be continuous emissions from separators, condensate storage tanks, flares or combustors, and daily tailpipe and fugitive dust emissions from operations traffic. During the operational phase of a well, NO_2, CO, VOC, and HAP emissions would result from the long-term use of storage tanks, pumps, separators, and other equipment. Additionally, dust (PM_{10} and $PM_{2.5}$) would be produced due to wind erosion on well pads and roads, and by vehicles servicing the wellsite infrastructure.

The BLM CFO emission estimates were developed from the BLM Single Oil and Gas Well Emission Inventory Tool (BLM Emission Inventory Tool) (BLM 2021). The BLM Emission Inventory Tool uses the EPA Compilation of Air Pollutant Emissions Factors (AP-42), EPA Motor Vehicle Emission Simulator , EPA Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling – Compression Ignition, and other sources (BLM 2023a). The tool has also been modified to account for Permian Basin gas profiles, typical project details, and recent New Mexico Energy, Minerals and Natural Resources Department (EMNRD) and NMED rules and regulations (Waste Prevention Rule and Ozone Precursor Rule). Production data from the S&P Global Marketplace database (commercial source) (BLM 2023a), including an estimate of the total potential mineral yield, or estimated ultimate recovery (EUR), and the associated decline rates were included in the BLM Emission Inventory Tool. Single well estimates and associated production data were based on horizontal drilling. The horizontally drilled single well emissions could be used in cases when well types are unknown, such as during leasing, providing a conversative estimate for vertically drilled wells (if vertical wells were to be drilled). Whereas this information provides an estimate of emissions based on typical development occurring in New Mexico, actual emissions from the development of any given well may differ. The CFO is calculating project-specific emissions on a project-specific basis. Emissions estimates per well are included in Table 2-8.

Table 2-8. Future Potential Development of the Lease Parcel Emissions

Future Potential Development	Lease Sale Emissions (tons per year)						
	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	VOC	HAPs
2020 NEI emissions (Eddy and Lea Counties)	13,570	4,600	59,510	82,081	91,287	227,325	25,271
Single well construction/ development phase	10.28	1.53	13.62	0.01	3.45	0.71	0.02
Single well operation phase	4.92	0.88	1.11	4.61E-03	1.34	10.54	0.93
Single well total	**15.20**	**2.41**	**14.73**	**0.02**	**4.79**	**11.25**	**0.95**
Total emissions from lease sale (32 horizontal wells)	486.4	77.12	471.36	0.47	153.28	360.00	30.40
Proposed Action percent of Eddy and Lea Counties Emissions	3.58%	1.68%	0.79%	0.001%	0.17%	0.16%	0.12%

Source: BLM (2021)

Note: The analysis contained in this table provides percentage contribution rounded to two decimal points. The representative well used to calculate emissions is a horizontal well.

Future potential development on the nominated lease parcels is estimated at 32 horizontal wells (one well per parcel) (see Table 2-8). The future potential development of the nominated lease parcels associated with the Proposed Action constitutes 0.16% of the projected wells in the reasonably foreseeable development (RFD) scenario (20,240 wells) and would be 3.2% of annual RFD (1,012 wells). Reasonably foreseeable trends and planned actions would incrementally contribute to increases in criteria pollutants that range between 0.001% to 3.58% of existing annual emissions of all well development, federal and non-federal (see Table 2-8).

The most substantial criteria pollutants and O_3 precursors emitted by oil and gas development and production are VOCs, HAPs, particulate matter, and NO_X. VOCs and NO_X contribute to the formation of O_3, which is the pollutant of most concern in the Permian Basin, and because O_3 is not a direct emission, emissions of NO_X and VOCs are used as proxies for estimating O_3 levels. Under the Proposed Action, the additional NO_X and VOC emissions (quantified in Table 2-8) from the well would incrementally add to O_3 levels within the analysis area, which currently has design values in Eddy County above the 70 ppb 2015 O_3 NAAQS. As discussed in Section 2.2.1.1, the New Mexico OAI showed 2028 projected future O_3 design values in southern New Mexico to be below the 70 ppb 2015 O_3 NAAQS when following EPA guidance, using the 2012–2016 current design value and the Oil and Gas Control Strategy (Oil and Gas Control Strategy) scenario. A sensitivity study using a current design value from 2015–2019 resulted in 2028 projected future O_3 design values below the 70 ppb 2015 O_3 NAAQS when using the Oil and Gas Control Strategy scenario. An additional sensitivity study using a current design value from 2017–2019 resulted in 2028 projected future O_3 design values above the 70 ppb 2015 O_3 NAAQS when using the Oil and Gas Control Strategy scenario. However, it should be noted that these sensitivity studies likely result in uncertainties and likely overstate the 2028 O_3 future design values in the Permian Basin emissions, as the scaling factor (relative response factor [RRF] = Σ Model2028 / Σ Model2014) does not account for emission increases in oil and gas sources between 2014 and the end of the 2010 decade. It should also be noted that the sensitivity studies did not follow EPA guidance, for which the current design value is the average of 3 years of O_3 design values centered on the base modeling year (NMED 2021). Additionally, the modeling results for the future year (2032) simulations for New Mexico from the BLM Regional CAP Model, which used BLM oil and gas development projections to quantify and apportion federal and non-federal oil and gas emissions, showed that O_3 cumulative concentrations ranged between 50 and 65 ppb in New Mexico. The highest modeled O_3 concentrations were seen in the San Juan Basin and isolated regions on the western side of New Mexico. The modeled values did not lead to any O_3 NAAQS exceedances in the state, including in the PDO area (BLM and Environmental Management and Planning Solutions, Inc. [EMPSi] 2023).

Levels of HAPs would also temporarily increase during construction and completion activities under the Proposed Action, particularly in the form of diesel particulate matter from the on- and off-road construction equipment. However, concentrations of mobile source emissions of diesel particulate matter are typically reduced by 60% at approximately 300 feet (Zhu et al. 2002). According to Zhu et al. (2002), the ultrafine particle (diameter less than 100 nanometers) concentration measured at 300 meters downwind from the source of emissions was indistinguishable from the upwind background concentration. The relatively steep drop-off with distance of diesel particulate matter concentrations and the short duration of the activity make the effects from exposure to HAP emissions minimal during construction. Additionally, a 2019 health assessment study completed by Colorado State University (ICF and Colorado State University 2019) during various stages of well development and production at oil and gas extraction facilities in Colorado found that chemical air concentrations for VOCs (including HAPs) and associated exposure levels decreased rapidly with distance. Simulated chronic cancer risks over a lifetime of exposure for average individuals were below 1 in 1 million at distances of 1,400 feet from the well pads, 4 in 1 million at 500 feet from the well pads, and 10 in 1 million at 300 feet from the well pads. Simulated chronic cancer risks over a lifetime of exposure for maximum exposed individuals were below 1 in 1 million at distances of 2,000 feet from the well pads, 7 in 1 million at 500 feet from the well pads, and 10 in 1 million at 400 feet from the well pads (ICF and Colorado State University 2019). Additional information related to HAPs and the Colorado State University study can be found in Section 5 of the Air Resources Technical Report (BLM 2023a), incorporated by reference.

Construction activities would be one of the primary sources of particulate matter emissions as a result of dust and fine particles generated from on-site equipment use and related groundwork, as well as on- and off-site vehicles (Araújo et al. 2014; Reid et al. 2010). How particulate matter interacts with the environment is dependent on a variety of factors, with the size and chemical composition of the airborne particles being the most important in terms of dispersion (distance from the source) and deposition from the atmosphere. Effects of all particulate matter emissions would not be confined to the construction site because $PM_{2.5}$ (fine particles) can travel farther in terms of distance than PM10 (dust) and other total suspended particulates (particles of sizes up to 50 micrometers) (Araújo et al. 2014). According to Araújo et al. (2014), construction site activities may influence the environment in the immediate area or neighborhood through emissions of total suspended particulates. Total suspended particulates are particles that have lower permanence in the atmosphere, thereby depositing near the emission sources (Araújo et al. 2014). The dispersion and concentration of particulate matter emissions depend on the technology and management control methods used by each project and the weather condition variables (i.e., wind speed, wind direction, and humidity/moisture) (Araújo et al. 2014). Compliance with state permitting requirements and following BMPs can reduce off-site effects from fugitive dust.

Emissions of CAPs would also occur outside the planning area from transport, processing, distribution, and end-use. New Mexico’s crude oil production has increased significantly since 2010. Most of it comes from the Permian Basin, which is located in eastern New Mexico and western Texas. The Permian Basin is one of the most prolific crude oil-producing areas in the nation and the world. Advanced drilling and oil recovery technologies have increased production from the Basin’s low-permeability shale formations. Generally, crude oil from the well fields in the Permian Basin is transported to the crude oil refinery in

Artesia, located in southeastern New Mexico. The refinery processes crude oils and serves markets in the southwestern United States and northern Mexico and primarily produces gasoline, diesel, and asphalt (EIA 2023a). Natural gas is produced from conventional oil and gas wells and shale gas in the Permian Basin in southeastern New Mexico. Interstate pipelines bring natural gas into New Mexico from Texas and Colorado and carry most of the natural gas that leaves the state to Arizona or back to Texas. Some of New Mexico's natural gas is placed in the state's two underground storage fields (EIA 2023a). Since combustion of all petroleum products emits criteria and HAP emissions, local ambient concentrations of these pollutants could increase in areas where products from the Permian Basin (oil and gas) are combusted. This could contribute to an area exceeding either national or local air quality standards. Air quality involves complex physical and chemical transformations at a local/regional level, so impacts would vary considerably depending on background concentrations, meteorology, and other local pollutant sources. If any pollutant concentration is near or above its standard in a particular area, the combustion of oil and gas products could contribute to or exacerbate nonattainment. Potential pollutant concentration change resulting from combustion is therefore often a key driver of public policy to mitigate air quality and public health impacts in such areas. Downstream combustion and end uses are regulated by the EPA or delegated to state agencies.

NO ACTION ALTERNATIVE

Under the No Action Alternative, the BLM would not affirm the issuance of the leases. However, in the absence of a Land Use Plan Amendment closing the lands to leasing, the parcels could be considered for inclusion in future lease sales. Although no new emissions resulting from new federal oil and gas development would occur under the No Action Alternative, the national and global demand for energy is not expected to differ, regardless of BLM decision-making.

MITIGATION MEASURES AND RESIDUAL EFFECTS

Based on the BLM's authority under the standard terms and conditions, the BLM requires industry to incorporate and implement BMPs, which are designed to reduce effects on air quality by reducing emissions, surface disturbances, and dust from field production and operations. Typical measures include requirements for watering dirt roads or applying magnesium chloride dust suppressants on dirt roads during periods of high use to reduce fugitive dust emissions of PM_{10}; colocation of wells and production facilities to reduce new surface disturbance; implementation of directional and horizontal drilling and completion technologies whereby one well provides access to petroleum resources that would normally require the drilling of several vertical wellbores; suggestions that vapor recovery systems be maintained and functional in areas where petroleum liquids are stored; green completions where technically feasible; and interim reclamation to revegetate areas not required for production facilities and reduce the amount of fugitive dust. Examples of additional air quality control measures imposed at the APD stage may include submission of an emissions inventory for the plan of development, air quality modeling, or implementation of mitigation measures and BMPs. The BLM would do this in coordination with the EPA, NMED, and other agencies that have jurisdiction over air quality. At the APD stage, COAs could be applied based on site-specific environmental analysis for the APD. Emission control techniques would be further evaluated when specific lease development projects are proposed.

The BLM also encourages industry to participate in the Natural Gas STAR program, administered by the EPA. The Natural Gas STAR program is a flexible, voluntary partnership that encourages oil and natural gas companies to adopt proven, cost-effective technologies and practices that improve operational efficiency and reduce natural gas emissions (BLM 2023a). Additionally, EPA and State of New Mexico rules/regulations help to reduce emissions. The EPA has NSPS in place at 40 C.F.R. § 60, Subparts OOOO and OOOOa, to reduce VOCs from well completion operations and storage tanks and impose emissions limits, equipment design standards, and monitoring requirements on oil and gas facilities.

The new EPA Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review will sharply reduce emissions of CH_4 and other harmful air pollution from oil and natural gas operations. The final action includes NSPSs to reduce CH_4 and smog-forming VOCs from new, modified, and reconstructed sources (EPA 2023d).

At the state level, the EMNRD published the New Mexico Oil Conservation Division Statewide Natural Gas Capture Requirements (Waste Prevention Rule), NMAC 19.15.27, on May 25, 2001, as part of the New Mexico statewide enforceable regulatory framework to secure reductions in oil and gas sector emissions and to prevent natural gas waste from new and existing sources. Key provisions include prohibition of unnecessary venting and flaring of waste natural gas where it is technically feasible to route the gas to pipeline or to use this gas for some other beneficial purpose (such as on-site fuel consumption). In all cases, operators must flare rather than vent natural gas except where this is technically infeasible or would pose a safety risk. These provisions will reduce VOC emissions due to stringent limitations on natural gas venting (natural gas venting results in uncombusted VOC emissions). Additionally, it proposes that natural gas be recovered and reused, rather than flared, which would result in reductions in VOCs, NO_X, CO, SO_2, greenhouse gases (GHGs), and particulate matter emissions. The NMED developed the "Oil and Natural Gas Regulation for Ozone Precursors," NMAC 20.2.50, which was published on July 26, 2022, with an effective date of August 5, 2022. Approximately 50,000 wells and associated equipment will be subject to this regulation. It is anticipated that the regulation will annually reduce VOC emissions by 106,420 tons, nitrogen oxide emissions by 23,148 tons, and CH_4 emissions by 200,000 to 425,000 tons. The regulation includes emissions reduction requirements for compressors, engines and turbines, liquids unloading, dehydrators, heaters, pneumatics, storage tanks, and pipeline inspection gauge launching and receiving. A description of federal and state rules and regulations can be found in Section 2 of the Air Resources Technical Report (BLM 2023a), incorporated by reference.

2.2.1.3 *Cumulative Effects*

Cumulative impacts for air quality are the result of the incremental impacts from the Proposed Action when added to other past, present, and reasonably foreseeable future actions. The sections below describe trends in air quality and how they relate to past and present oil and gas activities and projected emissions through modeling for the CFO RFD scenarios. The cumulative effects analysis area is the Permian Basin and the surrounding airshed. More information regarding cumulative effects can be found in Chapters 3, 6, 8, and 9 of the Air Resources Technical Report (BLM 2023a), incorporated by reference.

EMISSIONS TRENDS

Past and present actions that have affected and would likely continue to affect air quality in the analysis area include surface disturbance resulting from ongoing oil and gas development and associated infrastructure, geophysical exploration, ranching and livestock grazing, range improvements, recreation (including off-highway vehicle use), authorization of rights-of-way for utilities and other uses, and road development. Past and present actions that have affected and would likely continue to affect air quality are too numerous to list here but would include the development or conversion of power plants; the development of energy sources such as oil and gas; the development of highways and railways; and the development of various industries that emit pollutants. These types of actions and activities can reduce air quality through emissions of criteria pollutants including fugitive dust, VOCs, and HAPs, as well as contribute to deposition impacts and a reduction in visibility.

Emissions in the oil and gas sector roughly parallel oil and gas production. Future trends in oil and gas production growth for the Mountain Region (Montana, Idaho, Wyoming, Nevada, Utah, Colorado, Arizona, and New Mexico) are from the EIA 2023 Annual Energy Outlook (EIA 2023b) to provide an estimate of the change in emissions from oil and gas sources in New Mexico. U.S. production of natural gas and petroleum and liquids is projected to rise amid growing demand for exports and industrial uses. U.S. natural gas production is expected to increase by 15% from 2022 to 2050, while crude oil is expected to increase by 11% during the same period. Similarly, oil and gas–related CAP and HAP emissions from existing and foreseeable wells, plus development of lease parcels, are anticipated to rise due to increasing production.

Design value trends for pollutants in the Permian Basin can be found in Section 3 of the Air Resources Technical Report (BLM 2023a), incorporated by reference. O_3 (8-hour) design value trends from the 2011–2013 design value to the 2020–2022 design value indicate a slight increase to a steady trend, depending on the county in the Permian Basin. NO_X (annual and 1-hour) shows a flat to increasing trend, and $PM_{2.5}$ (annual and 24-hour) shows a slightly decreasing trend.

REASONABLY FORESEEABLE DEVELOPMENT

While there are other sources of emissions in the CFO, the oil and gas industry is one of the most prominent sources of emissions. Approximately 45,579 active oil and gas wells are in the New Mexico portion of the Permian Basin. Of this total, roughly 24,990 wells are federal, with the remainder falling in other jurisdictions (BLM 2023a). Over the past 7 years, there have been a total of 3,493 federal well completions, all of which occurred within the Pecos District (Table 2-9).

Table 2-9. Past and Present Federal Well Completions

Number of Federal Well Completions*	2016	2017	2018	2019	2020	2021	2022
Pecos District	150	199	261	284	1,160	587	852

Source: Petroleum Engineering Group, PDO (BLM 2023a)

*The number of well completions within the PDO.

The RFD scenario for oil and gas in the CFO (Engler 2023) projects that on average, 980 oil and gas wells would be completed within the CFO planning area each year over the 20-year scenario (2023–2043), for approximately 19,600 new wells (federal and non-federal), most of which are expected to be horizontally drilled. Of this, at least 12,500 wells in CFO planning area alone would be federal (Engler 2023). CFO well spud projections by year vary from 1,208 new federal and non-federal well spuds (770 federal) in 2023 to 769 new federal and non-federal well spuds (490 federal) in 2043. The CFO planning area encompasses Lea and Eddy Counties and portions of Chaves County. The CFO RFD does not account for future well development in the Roswell Field Office (RFO) portion of the PDO planning area (which encompasses portions of Chaves and Roosevelt Counties); therefore, well projections for the RFO planning area were extracted from the PDO RFD (Engler et al. 2012; Engler and Cather 2014). The PDO RFD projects that 800 oil and gas wells would be completed within the PDO each year for the 20-year scenario (2015–2035), for a total of approximately 16,000 new wells (federal and non-federal), most of which are expected to be horizontally drilled. Based on the review of cumulative production volumes through 2010 (see Summary Table 1 [page 49] in Engler and Cather 2012), most of the production has occurred in Eddy and Lea Counties, and development in Chaves and Roosevelt Counties represents approximately 4% of the cumulative production volumes for the PDO planning area. Assuming that this proportion of development in Chaves and Roosevelt Counties relative to the larger PDO planning area would remain relatively stable into the future, the number of projected wells from the PDO RFD that are likely to occur within Chaves and Roosevelt Counties would be approximately 640. When combined, the total number of projected wells for the PDO planning area is 20,240 (including 19,600 wells in CFO and 640 wells in RFO). PDO RFD projections over a 20-year time period show well development with an average of 1,012 wells per year (of which at least 625 would be federal). The BLM Air Resources

Technical Report (BLM 2023a) provides information related to the RFD for the PDO planning area. Annual well averages are multiplied by the one oil-well pollutant emission factor (Table 2-10) to calculate reasonably foreseeable future action annual emissions for both federal well development and federal and non-federal well development associated with the RFD scenarios (see Table 2-10). PDO RFD emissions are also compared with the 2020 NEI data for the Permian Basin (Eddy, Lea, Chaves, and Roosevelt Counties) in Table 2-10.

Table 2-10. Total and Federal PDO Emissions per Year Based on the RFD

PDO RFD	RFD Emissions (tons per year)						
	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO	VOC	HAPs
Single well construction/ development phase	10.28	1.53	13.62	0.01	3.45	0.71	0.02
Single well operation phase	4.92	0.88	1.11	4.61E-03	1.34	10.54	0.93
Single well total	15.20	2.41	14.73	0.02	4.79	11.25	0.95
Total emissions from PDO RFD (1,012 wells)	15,382.40	2,438.92	14,906.76	20.24	4,847.48	11,385.00	961.40
Federal emissions from PDO RFD (625 wells)	9,500.00	1,506.25	9,206.25	12.50	2,993.75	7,031.25	593.75
2020 NEI Permian Basin (Eddy, Lea, Chaves, and Roosevelt Counties) emissions	20,585	6,270	66,098	83,521	109,477	252,387	30,508
Total RFD percent of PDO emissions (1,012 wells)	74.7%	38.9%	22.6%	0.02%	4.4%	4.5%	3.2%
Federal RFD percent of PDO emissions (625 wells)	46.2%	24.0%	13.9%	0.01%	2.7%	2.8%	1.9%

Note: The analysis contained in this table provides percentage contribution rounded to two decimal points. The representative well used to calculate emissions is a horizontal well.

2.2.1.4 *Air Quality and Air Quality-Related Values Modeling*

NEW MEXICO OZONE ATTAINMENT INITIATIVE STUDY

The State of New Mexico initiated the New Mexico OAI Photochemical Modeling Study in spring 2018 to address the high O_3 concentrations, protect the O_3 attainment status, and ensure the health and welfare of the residents of the state for future generations (NMED 2021). Based on the WRAP/WAQS Comprehensive Air Quality Model with extensions (CAM_X) 2014 36-/12-kilometer modeling platform, a CAM_X 2014 36-/12-/4-kilometer O_3 modeling platform was developed with the 4-kilometer domain focused on New Mexico and adjacent states. The study also looked at a 2028 Base Case future year modeling and an Oil and Gas Control Strategy scenario that implemented proposed controls on 2028 New Mexico oil and gas sources. The 2028 Oil and Gas Control Strategy reduced oil and gas combustion–related NO_X emissions by approximately 21,000 tons per year (or by 64%, compared with the 2028 Base Case) and VOC emissions from oil and gas by approximately 53,000 tons per year (or by 46%, compared with the 2028 base case [NMED 2021]). This study has been incorporated by reference.

The 2028 Base Case and 2028 Oil and Gas Control Strategy modeling results followed EPA guidance (EPA 2018), which recommended using a current year design value based on an average of three O_3 design values centered on the base modeling year (in this study, 2014). As a result, this part of the study used a current year design value from 2012–2016. To develop the 2028 O_3 future year design values for the specific scenarios, the current year design value (2012 –2016, average of three design values over 5 years) was scaled by RRF, which are model-derived scaling factors. In this study, the RRF are the ratio of the 2028 future scenario (Base Case or Oil and Gas Control Strategy) over the 2014v2 Base Case CAM_X O_3 results (RRF = Σ Model2028 / Σ Model2014). This method allowed for the development of a projected 2028 O_3 future year design value for the respective scenarios (Base Case or Oil and Gas Control Strategy). The current 2012–2016 O_3 design values at southern New Mexico sites range from 62.0 ppb to 72.0 ppb. The 2028 Base Case saw future O_3 design value reductions of -2.0 to -6.3 ppb in this area, including reductions of -2.3 ppb at Carlsbad and -2.0 ppb at Hobbs in Eddy and Lea Counties. The 2028 Base Case future O_3 design values in southern New Mexico ranged from 59.0 to 67.0 ppb. The 2028 Oil and Gas Control Strategy saw future O_3 design value reductions of -0.1 to -0.7 ppb, including reductions of -0.3 ppb at Carlsbad and -0.7 ppb at Hobbs in Eddy and Lea Counties, from the 2028 Base Case. The 2028 projected Oil and Gas Control Strategy O_3 design values in southern New Mexico ranged from 58.9 to 66.8 ppb. Using this method and following EPA guidance, all 2028 projected O_3 future design values at monitoring sites in New Mexico were below the 70 ppb 2015 O_3 NAAQS using the 2012–2016 design value (NMED 2021).

With the recent upward trend in O_3 values in southeast New Mexico, the New Mexico OAI study also looked at more recent design values (2015–2019 and 2017–2019) (NMED 2021). A similar method to determine the future 2015–2019 and 2017–2019 design values was used as described above. However, it should be noted that because the study is using the CAM_X 2014v2 Base Case results as the denominator in the RRF equation (RRF = Σ Model2028 / Σ Model2014) to develop 2028 O_3 future design value projections, any emission changes (increases or decreases) between 2014 and the end of the 2010 decade will not be accounted for (for example, increases in oil and gas source emissions and decreases in mobile source emissions). This will result in uncertainties and will likely overstate the 2028 O_3 future design values in the Permian Basin emissions, as emissions from oil and gas sources were higher at the end of the 2010 decade than in 2014 (NMED 2021).

The current 2015–2019 O_3 design values at all New Mexico sites selected for this sensitivity test ranged from 65.0 to 74.3 ppb and included both Carlsbad (73.7 ppb) and Hobbs (69.3 ppb) in Eddy and Lea Counties. The 2028 Base Case saw future O_3 design value reductions of -1.7 to -6.6 ppb, including reductions of -2.5 ppb at Carlsbad and -2.1 ppb at Hobbs in Eddy and Lea Counties. The 2028 projected Base Case O_3 design values at all New Mexico sites selected for this sensitivity test ranged from 61.0 to 71.2 ppb. Note that the 2015–2019 future O_3 design value had one monitoring site (Carlsbad) that exceeded the 2015 O_3 NAAQS at 71.2 ppb. The 2028 Oil and Gas Control Strategy saw future O_3 design value reductions of 0.0 to -1.5 ppb, including reductions of -0.3 ppb at Carlsbad and -0.7 ppb at Hobbs in Eddy and Lea Counties, from the 2028 Base Case. The 2028 projected Oil and Gas Control Strategy O_3 design values at all New Mexico sites selected for this sensitivity test ranged from 60.5 to 70.9 ppb. Emission controls in the 2028 Oil and Gas Control Strategy were sufficient to reduce the 2028 future O_3 value at Carlsbad (70.9 ppb) to below the O_3 NAAQS (NMED 2021). The current 2017–2019 O_3 design values at all New Mexico sites selected for this sensitivity test ranged from 66.0 to 79.0 ppb and included both Carlsbad (79.0 ppb) and Hobbs (71.0 ppb) in Eddy and Lea Counties (both above the 2015 O_3 NAAQS). The 2028 Base Case saw future O_3 design value reductions of -2.1 to -6.7 ppb, including reductions of -2.6 ppb at Carlsbad and -2.1 ppb at Hobbs in Eddy and Lea Counties. The 2028 projected Base Case O_3 design values at all New Mexico sites selected for this sensitivity test ranged from 61.9 to 76.4 ppb. Note that the 2015–2019 future O_3 design value had two monitoring sites (Carlsbad, with 76.4 ppb, and Desert View, Doña Ana County, with 71.6 ppb) that exceeded the 2015 O_3 NAAQS. The 2028 Oil and Gas Control Strategy saw future O_3 design value reductions of 0.0 to -1.5 ppb, including reductions of -0.3 ppb at Carlsbad and -0.7 ppb at Hobbs in Eddy and Lea Counties, from the 2028 Base Case. The 2028 projected Oil and Gas Control Strategy O_3 design values at all New Mexico sites selected for this sensitivity test ranged from 61.4 to 76.0 ppb.

The 2028 future design value at Carlsbad of 76.0 ppb, with the Oil and Gas Control Strategy, exceeds the 2008 and 2015 O_3 NAAQS. However, as mentioned above, the design of this sensitivity study will result in uncertainties and will likely overstate the 2028 O_3 future design values in the Permian Basin, as emissions from Oil and Gas sources were higher at the end of the 2010 decade than in 2014 (NMED 2021). The final part of the New Mexico OAI study investigated source apportionment and was conducted to determine the contributions of source sectors to 2028 future year O_3 design values under the Oil and Gas Control Strategy scenario. One investigation involved international emissions. The Speciated Modeled Attainment Test O_3 projection tool was run without the contributions of international anthropogenic emissions for current design values (2012–2016, 2015–2019, and 2017–2019). In New Mexico, international anthropogenic emissions contributed 11 to 26 ppb to the projected 2028 future design values. The Carlsbad site had reductions of 20.3 ppb, 21.7 ppb, and 23.2 ppb under all three design value scenarios (2012–2016, 2015–2019, and 2017–2019), respectively. Carlsbad, which had produced a projected 2028 O_3 exceedance for both the 2008 and 2015 O_3 NAAQS under the current design value for the 2017–2019 scenario, was below 55 ppb for a future design value under all three design value scenarios (2012–2016, 2015–2019, and 2017–2019) (NMED 2021).

2032 BLM REGIONAL CRITERIA AIR POLLUTANT PHOTOCHEMICAL MODELING STUDY

The BLM developed a photochemical model using the CAM_X photochemical modeling platform and 12-kilometer grid spacing to assess the impacts of oil and gas development and coal production and other cumulative sources on air quality in the western United States (Utah, Colorado, New Mexico, Wyoming, Montana, North Dakota and South Dakota). The modeling analysis evaluated air quality and AQRVs out to a future year of ca. 2032 using data from the WRAP/WAQS modeling platform, the EPA’s 2016v2 emissions modeling platform (EPA 2022e), and the BLM oil and gas development projections to quantify and apportion federal and non-federal oil and gas emissions (BLM and EMPSi 2023). The photochemical modeling was conducted using a scenario that included coal, oil and gas development, natural and other anthropogenic emissions, representative of the cumulative sources around the year 2032. Additional methodology can be found in the BLM Regional Criteria Air Pollutant Photochemical Modeling Study (BLM and EMPSi 2023), incorporated by reference.

The BLM Regional Criteria Air Pollutant Modeling Study (BLM and EMPSi 2023) results show that the cumulative concentrations over New Mexico range between 50 ppb and 65 ppb in New Mexico, with the higher concentrations in the San Juan Basin and isolated regions on the west side of the state. The modeled values did not lead to any O_3 NAAQS exceedances in the state, including for the Pecos District. The largest contributions to O_3 are due to the modeled boundary conditions, followed by other anthropogenic sources (i.e., those not including oil, gas, or coal source groups) and natural sources.

The 1-hour NO_2 modeled cumulative concentrations showed the highest concentrations over the San Juan Basin (highest value of 60.0 ppb); the El Paso, Texas area; and the Permian Basin. The modeled values did not lead to any 1-hour NO_2 NAAQS exceedances in the state, including for the Pecos District. The largest contributions to 1-hour NO_2 are due to federal, non-federal, and tribal oil and gas development.

The 24-hour $PM_{2.5}$ modeling showed a northwest to southeast gradient, with larger $PM_{2.5}$ concentrations on the southeast side of New Mexico. The largest 24-hour $PM_{2.5}$ concentration in the state is 47.2 $\mu g/m^3$ in Socorro County (primarily due to wildfires). As a result, the modeled values did exceed the 24-hour $PM_{2.5}$ NAAQS in Socorro County, New Mexico, but nowhere else in the state, including the Pecos District, was the NAAQS exceeded. The largest contributors to 24-hour $PM_{2.5}$ are wildfires and non-coal, oil, or gas anthropogenic sources. Annual $PM_{2.5}$ modeled values showed cumulative concentrations over New Mexico did lead to an annual $PM_{2.5}$ NAAQS exceedance over the Albuquerque area based on the new $PM_{2.5}$ NAAQS standard of 9.0 µg/m^3, but nowhere else in the state, including the Pecos District, was the NAAQS exceeded. Cumulative annual $PM_{2.5}$ concentrations were highest near Albuquerque (9.2 µg/m^3), which were due to other anthropogenic sources (i.e., those not including oil, gas, or coal source groups) and generally less than 4 µg/m^3 within the rest of New Mexico. The largest contributors to annual $PM_{2.5}$ are the anthropogenic and wildfire sources.

The 24-hour PM_{10} cumulative concentrations showed PM_{10} NAAQS exceedances in a few grid cells in southwestern New Mexico (primarily due to wildfires), but nowhere else in the state, including the Pecos District, was the NAAQS exceeded. PM_{10} cumulative concentrations over most of New Mexico ranged between 2 and 30 milligrams per cubic meter (mg/m^3), with smaller areas of concentrations between 30 and 150 mg/m^3. The largest contributors to annual PM_{10} are wildfires and other anthropogenic sources (i.e., those not including oil, gas, or coal source groups).

The 1-hour SO_2 modeled cumulative concentrations over New Mexico did not lead to any 1-hour SO_2 NAAQS exceedances, including for the Pecos District. Most of the state had concentrations that did not exceed 10 ppb, except for a few southeastern counties (e.g., Eddy, Lea, and Roosevelt Counties) where concentrations ranged from 5 to 69 ppb. The largest contributors to 1-hour SO_2 concentrations in New Mexico are oil and gas activities and wildfires. The 3-hour SO_2 modeled cumulative concentrations showed no exceedances of the 3-hour SO_2 NAAQS, including for the Pecos District. The largest contributors to the 3-hour SO_2 concentrations in New Mexico were oil and gas activities, other anthropogenic sources (i.e., those not including oil, gas, or coal source groups), and wildfires.

The 1-hour CO modeled cumulative concentrations over New Mexico did not lead to any 1-hour CO NAAQS exceedances, including for the Pecos District. Most of the state had concentrations less than 5 ppm, although Socorro County had concentrations up to 10 ppm. The 8-hour CO modeled cumulative concentrations over New Mexico did not lead to any 8-hour CO NAAQS exceedances, including for the Pecos District. Most of the state had concentrations less than 5 ppm, although Socorro County had concentrations up to 6.9 ppm. The location of the higher 1-hour and 8-hour CO concentrations is the same location as the PM_{10} peak, indicating that natural sources (likely fires) are responsible for the higher 1-hour and 8-hour CO concentrations in this area (BLM and EMPSi 2023).

Cumulative annual nitrogen deposition over most of New Mexico varies between around 1 and 6 kilograms of nitrogen per hectare (kg N/ha-year) with an east-to-west gradient. The eastern part of the state shows nitrogen deposition generally between 2 and 6 kg N/ha-year, whereas the west side of the state is generally lower, with nitrogen deposition ranging from 1 to 4 kg N/ha-year (although higher deposition is present in a few grid cells in San Juan County). The cumulative average nitrogen deposition ranges from 1.2 at Petrified Forest National Park to 2.7 kg N/ha-year at Carlsbad Caverns National Park. None of the areas exceed the critical load thresholds for cumulative average nitrogen deposition. The largest contributors to the cumulative average nitrogen deposition are other anthropogenic sources (i.e., those not including oil, gas, or coal source groups), ranging from 40% to 60% depending on the area of interest. Cumulative annual sulfur deposition over most of New Mexico ranges between 0.1 and 2.0 kilograms of sulfur per hectare (kg S/ha-year), with higher concentrations in the southeastern part of the state. In the southeastern part of the state, concentrations generally range between 1 and 4 kg S/ha-year (although a few grid cells show concentrations between 4 and 9 kg S/ha-year in Roosevelt, Eddy, and Lea Counties.) The cumulative average sulfur deposition ranges from 0.1 at Petrified Forest National Park/Great Sand Dunes National Park to 1.8 kg S/ha-year at Carlsbad Caverns National Park. None of the areas exceed for the critical load thresholds for cumulative average sulfur deposition. The largest contributors to sulfur deposition in New Mexico are oil and gas non-federal and existing federal sources (BLM and EMPSi 2023). Additional modeling results can be found in the BLM Regional Criteria Air Pollutant Photochemical Modeling Study (BLM and EMPSi 2023), incorporated by reference.

SUMMARY

In summary, atmospheric concentrations for CAPs in the project area are projected to be below the NAAQS based on future year modeling. O_3, which is currently above the NAAQS in Eddy County, is projected to be below the NAAQS in the CFO area in future year (ca. 2032) modeling. NMED modeling following EPA guidance showed 2028 future year design values below the NAAQS (using the 2012–2016 design value). Sensitivity analyses by NMED showed 2028 future design values at Carlsbad (using the 2017–2019 design value), with the Oil and Gas Control Strategy, exceeding the 2008 and 2015 O_3 NAAQS. However, the design of this sensitivity study would result in uncertainties and would likely overstate the 2028 O_3 future design values in the Permian Basin, as emissions from oil and gas sources are higher at the end of the 2010 decade than in 2014. $PM_{2.5}$, another pollutant of concern, showed both annual and 24-hour ca. 2032 values below the NAAQS in the project area. Visibility is generally projected to be steady or improving at IMPROVE monitors near the project area (BLM 2023b). Nitrogen deposition at NPS monitors near the project area show generally poor to fair conditions with no trends available, while sulfur deposition conditions are generally poor to good with no trend or a relatively unchanging trend (where trend data is available).

Using the best science and data available (EPA's AirToxScreen), the current Lea and Eddy Counties cancer risk—20.16 and 22.25 in 1 million people, respectively—is within the contextual range published by the EPA. New production from the foreseeable development of the Proposed Action and from approved and pending APDs should outweigh the production decline from currently producing wells (EIA 2023a) and result in slightly higher future HAPs emissions. However, an increase in oil and gas–related HAPs emissions should not make a substantial change to cumulative HAPs impacts since the total county cancer risk is well within the contextual range published by the EPA, and the oil and gas industry contributes a small percentage (county maximum of 18%) to the overall cancer risk.

2.2.2 Issue 2: Greenhouse Gases and Climate Change

How would future potential development of leases contribute to greenhouse gas (GHG) emissions and climate change?

Future development of lease parcels under consideration could lead to emissions of methane (CH_4), carbon dioxide (CO_2), and nitrous oxide (N_2O); the three most common GHGs associated with oil and gas development. These GHG emissions would be emitted from activities occurring on the leased parcels, and from the consumption of any fluid minerals produced. However, the BLM cannot reasonably determine at the leasing stage whether, when, and in what manner a lease would be explored or developed.
The uncertainty that exists at the time the BLM offers a lease for sale includes crucial factors that would affect actual GHG emissions and associated impacts, including but not limited to, the future feasibility of developing the lease; well density; geological conditions; development type (vertical, directional, or horizontal); hydrocarbon characteristics; specific equipment used during construction, drilling, and production; abandonment operations; product transportation; and potential regulatory changes over the 10-year primary lease term. Actual development on a lease is likely to vary from what is analyzed in this EA and will be evaluated through a site-specific NEPA analysis when an operator submits an APD or plan of development to the BLM.

For the purposes of this analysis, the BLM has evaluated the potential climate change impacts of the proposed leasing action by estimating and analyzing the projected potential GHG emissions from oil and gas development on the parcels. Projected emissions estimates are based on previous actual oil and gas development analyses, and any available information from existing development within the state.

Further discussion of climate change science and predicted impacts as well as the reasonably foreseeable and cumulative GHG emissions associated with BLM's oil and gas leasing actions and methodologies are included in the *2022 BLM Specialist Report on Annual Greenhouse Gas Emissions and Climate Trends* (BLM 2023b) (Annual GHG Report). This report presents the estimated emissions of GHGs attributable to development and consumption of fossil fuels produced on lands and mineral estate managed by the BLM. The Annual GHG Report is incorporated by reference as an integral part of this analysis.

2.2.2.1 *Affected Environment*

Climate change is a global process that is affected by the sum total of GHGs in the Earth's atmosphere. GHGs act to contain solar energy loss by trapping longer wave radiation emitted from the Earth's surface and act as a positive radiative forcing component. GHGs influence the global climate by increasing the amount of solar energy retained by land, water bodies, and the atmosphere. GHGs can have long atmospheric lifetimes, which allows them to become well mixed and uniformly distributed over the entirety of the Earth's surface no matter their point of origin. The buildup of these gases has contributed to the current changing state of the climate equilibrium towards warming. A discussion of past, current, and projected future climate change impacts is described in Chapters 4, 8, and 9 of the Annual GHG Report (BLM 2023b). These chapters describe currently observed climate impacts globally, nationally, and in each state, and present a range of projected impact scenarios depending on future GHG emission levels.

The incremental contribution to global GHGs from a single proposed land management action cannot be accurately translated into its potential effect on global climate change or any localized effects in the area specific to the action. Currently, global climate models are unable to forecast local or regional effects on resources resulting from a specific subset of emissions. However, there are general projections regarding potential impacts on natural resources and plant and animal species that may be attributed to climate change resulting from the accumulation of GHG emissions over time. In this EA, the BLM uses GHG emissions as a proxy for impacts and provides context with other proxies such as GHG equivalents and the social cost of GHGs.

For the purposes of this EA, the projected emissions from the Proposed Action can be compared to modeled emissions that have been shown to have definitive or quantifiable impacts on the climate in order to provide context of their potential contribution to climate change. Table 2-11 shows the total estimated GHG emissions from fossil fuels at the global, national, and state scales from 2016 to 2021 (6 years). Emissions are shown in megatonnes (Mt) per year of carbon dioxide (CO_2). Chapter 3 of the Annual GHG Report contains additional information on GHGs and an explanation of CO_2e. State and national energy-related CO_2 emissions include emissions from fossil fuel use across all sectors (residential, commercial, industrial, transportation, and electricity generation) and are released at the location where the fossil fuels are consumed.

Table 2-11. Global, United States, and New Mexico Fossil Fuel GHG Emissions, 2016–2021 (Mt CO_2/year)

Scale	2016	2017	2018	2019	2020	2021
Global	36,465.6	36,935.6	37,716.2	37,911.4	35,962.9	37,500.0
United States	4,909.9	4,852.5	4,989.8	4,855.9	4,344.9	4,639.1
New Mexico	48.8	49.4	45.2	48.4	45.0	46.0

Sources: Annual GHG Report (BLM 2023b:Chapter 5, Table 5-1 [U.S.] and Table 5-2 [State]). Global emissions (CO_2 only): GHG Emissions of all World Countries 2023 Report (Emissions Database for Global Atmospheric Research 2023). State 2021 data: Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021 (EPA 2023e).

Mt (megatonne) = 1 million metric tonnes

Additional information on current state, national, and global GHG emissions as well as the methodology and parameters for estimating emissions from BLM fossil fuel authorizations and cumulative GHG emissions is included in Chapters 5, 6, and 7 of the Annual GHG Report.

2.2.2.2 *Environmental Consequences*

PROPOSED ACTION

While the leasing action does not directly result in development that would generate GHG emissions, emissions from future potential development of the leased parcels can be estimated for the purposes of this analysis. Four general phases of post-lease development processes would generate GHG emissions: 1) well development (well site construction, well drilling, and well completion), 2) well production operations (extraction, separation, gathering), 3) mid-stream (refining, processing, storage, and transport/distribution), and 4) end use (combustion or other uses) of the fuels produced. While well development and production operation emissions (phases 1 and 2) occur on-lease and the BLM has program authority over these activities, mid-stream and end-use emissions (phases 3 and 4) typically occur off-lease where the BLM has no program authority.

Emissions inventories at the leasing stage are imprecise due to uncertainties, including the type of mineral development (oil, gas, or both), scale, and duration of potential development, types of equipment (drill rig engine tier rating, horsepower, fuel type), and the mitigation measures that a future operator may propose in their development plan. Due to these uncertainties, the BLM applies several assumptions to estimate emissions at the leasing stage. The number of estimated wells per parcel is based on state data for past lease development combined with per-well drilling, development, and operating emissions data from representative wells in the area. The amount of oil or gas that may be produced if the offered parcels are developed is unknown.

For purposes of estimating production and end-use emissions, potential wells are assumed to produce oil and gas in similar amounts as existing nearby wells. While the BLM has no authority to direct or regulate the end use of the products, for this analysis, the BLM assumes all produced oil or gas would be combusted (such as for domestic heating or energy production). The BLM acknowledges that there may be additional sources of GHG emissions along the distribution, storage, and processing chains (commonly referred to as midstream operations) associated with production from the lease parcels. These sources may include emissions of CH_4 (a more potent GHG than CO_2 in the short term) from pipeline and equipment leaks, storage, and maintenance activities. These sources of emissions are highly speculative at the leasing stage; therefore, the BLM has chosen to assume that mid-stream emissions associated with lease parcels for this analysis would be similar to the national level emissions identified by the Department of Energy's National Energy Technology Laboratory (NETL; 2009, 2019). Section 6 of the Annual GHG Report includes a more detailed discussion of the methodology for estimating midstream emissions.

The emission estimates calculated for this analysis were generated using the assumptions previously described above in the BLM Lease Sale Emissions Tool (BLM 2024b) and lease development analysis. Emissions are presented for each of the four phases of post-lease development processes described above.

- Well development emissions occur over a short period and may include emissions from heavy equipment and vehicle exhaust, drill rig engines, completion equipment, pipe venting, and well treatments such as hydraulic fracturing.
- Well production operations, mid-stream, and end-use emissions occur over the entire production life of a well, which is assumed to be 20 years for this analysis based on the productive life of a typical oil/gas field.

- Production operation emissions may result from storage tank breathing and flashing, truck loading, pump engines, heaters and dehydrators, pneumatic instruments or controls, flaring, fugitives, and vehicle exhaust.
- Mid-stream emissions occur from the transport, refining, processing, storage, transmission, and distribution of produced oil and gas. Mid-stream emissions are estimated by multiplying the EUR of produced oil and gas with emissions factors from NETL life cycle analysis of U.S. oil and natural gas. Additional information on emission factors can be found in the Annual GHG Report (BLM 2023b:Chapter 6, Tables 6-8 and 6-10).
- For the purposes of this analysis, end-use emissions are calculated assuming all produced oil and gas is combusted for energy use. End-use emissions are estimated by multiplying the EUR of produced oil and gas with emissions factors for combustion established by the EPA (Tables C-1 and C-2 to Subpart C of 40 C.F.R. § 98). Additional information on emission factors and EUR factors can be found in the Annual GHG Report (BLM 2023b:Chapter 6).

Table 2-12 shows the estimated maximum year and average year GHG emissions over the life of the lease for both 100-year and 20-year global warming potentials (GWPs). Section 3.4 of the Annual GHG Report provides a detailed explanation of GWP.

Table 2-12. Estimated Direct and Indirect Emissions from Lease Parcels on an Annual and Life of Lease Basis (metric tonnes)

Timeframe	CO_2	CH_4	N_2O	CO_2e (100-year)	CO_2e (20-year)
Maximum Year	516,380	592.85	3.487	534,999	566,242
Average Year	168,761	215.90	1.132	175,504	186,882
Life of Lease	4,894,073	6,261.13	32.833	5,089,618	5,419,580

Source: BLM Lease Sale Emissions Tool (BLM 2024b)

Table 2-13 lists the estimated direct (well development and production operations) and indirect (mid-stream and end-use) GHG emissions in metric tonnes for the subject leases over the average 20-year production life of the lease. In summary, potential GHG emissions from the Proposed Action could result in GHG emissions of 5,089,618 metric tonnes of CO_2e over the life of the lease.

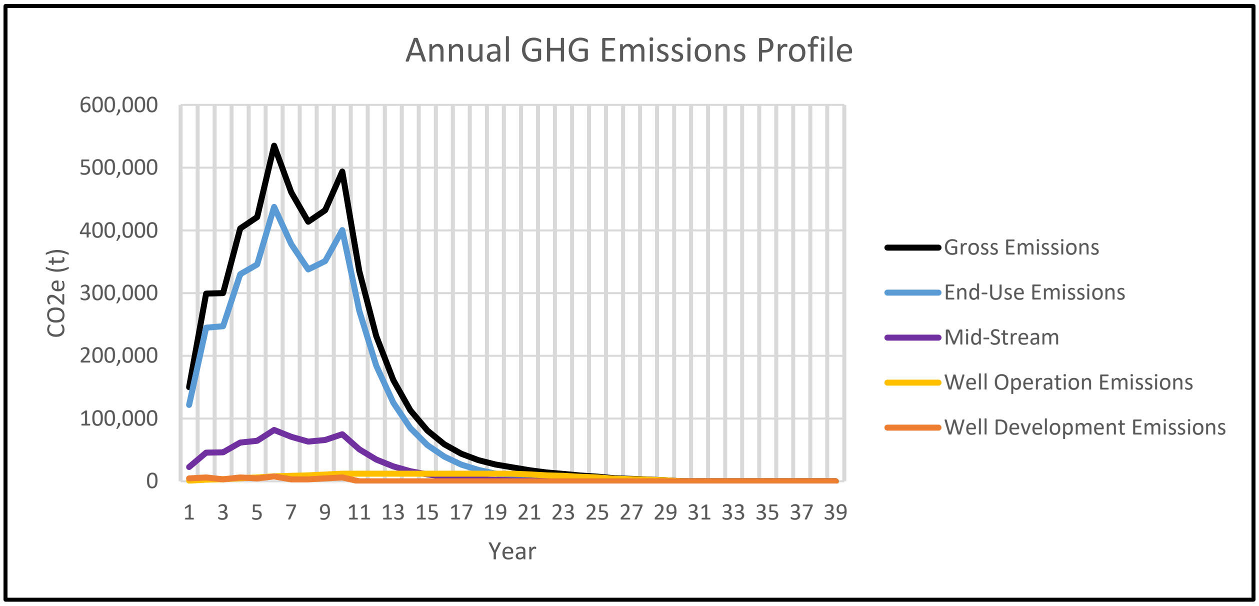
Table 2-13. Estimated Life-of-Lease Emissions from Well Development, Well Production Operations, Mid-stream, and End-use (metric tonnes)

Activity	CO_2	CH_4	N_2O	CO_2e (100-year)	CO_2e (20-year)
Well development	49,300	13.12	0.384	49,796	50,487
Well production operations	210,586	1,081.60	1.280	243,167	300,167
Mid-stream	605,046	5,040.77	9.257	757,788	1,023,437
End-use	4,029,142	125.64	21.912	4,038,868	4,045,489
Total (life of lease)	**4,894,074**	**6,261.13**	**32.833**	**5,089,619**	**5,419,580**

Source: BLM Lease Sale Emissions Tool (BLM 2024b)

Note: Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report GWP: 100-year GWP (CO_2 = 1, CH_4 = 29.8, N_2O = 273); 20-year GWP (CO_2 = 1, CH_4 = 82.5, N_2O = 273) (IPCC 2021).

GHG emissions vary annually over the production life of a well due to declining production rates over time. Figure 2-1 shows the estimated GHG emissions profile over the production life of a typical lease including the four phases of lease development processes: well development, well production operations, mid-stream, end use, and gross (total of well development, well production, mid-stream, and end-use) emissions.



Source: BLM Lease Sale Emissions Tool (BLM 2024b)

Figure 2-1. Estimated annual GHG emissions profile over the life of a lease.

To put the estimated GHG emissions for this lease sale in a relatable context, potential emissions that could result from development of the lease parcels for this sale can be compared to other common activities that generate GHG emissions. The EPA GHG equivalency calculator can be used to express the potential average year GHG emissions on a scale relatable to everyday life (EPA 2023f). For instance, the projected average annual GHG emissions from potential development of the subject lease are equivalent to 41,770 gasoline-fueled passenger vehicles driven for 1 year, or the emissions that could be avoided by operating 46.2 wind turbines as an alternative energy source or offset by the carbon sequestration of 204,906 acres of forest land for 1 year.

Table 2-14 compares emission estimates over the 20-year life of the lease compared to the 30-year projected federal fossil fuel emissions in the state and nation from existing wells, the development of approved APDs, and emissions related to reasonably foreseeable lease actions. The production life of a lease can vary by location, the type of well, and other factors, but a well can usually remain productive for a few decades. For this analysis the BLM assumes that leases will remain productive for 20 years. Well development is assumed to take place over the 10-year lease term, with a potential for a well to be developed in the 10th year and produce for 20 years. Therefore, well operation emissions and indirect emissions (midstream and end-use) are assumed to occur from the first year until year 29, with well development emissions potential occurring from the first year until the 10th year. This value differs slightly from EIA long-term (30-year) energy demand and emissions projections. For comparison, a well in New Mexico that produces for 20 years instead of 30 will result in total life-cycle emissions that are approximately 4% less of CO_2e (100-year GWP) and 5% less of CO_2e (20-year GWP).

Table 2-14. Comparison of the Life-of-Lease Emissions to Other Federal Oil and Gas Emissions

Reference	Mt CO_2e (100-year)	Life of Lease Percentage of Reference
Lease sale emissions (life of lease)	5.09	100.00%
New Mexico reasonably foreseeable short-term federal (oil and gas)*	3,183.17	0.16%
New Mexico EIA-projected long-term federal (oil and gas)†	9,961.81	0.05%
United States reasonably foreseeable short-term federal (oil and gas)	6,033.00	0.08%
United States EIA projected long-term federal (oil and gas)	16,523.00	0.03%

Source: U.S. and federal emissions from BLM Lease Sale Emissions Tool (BLM 2024b) data and Tables 7-18, 7-19 and Section 7 of the 2022 Annual GHG Report (BLM 2023b).

* Short-term foreseeable is estimated federal emissions from existing producing wells, approved APDs, and 1 year of leasing.

† Long-term foreseeable are estimated federal emissions to meet EIA-projected energy demand.

Compared to emissions from other existing and foreseeable federal oil and gas development, the life of lease emissions for the Proposed Action are between 0.05% and 0.16% of federal fossil fuel authorization emissions in the state and between 0.03% and 0.08% of federal fossil fuel authorization emissions in the nation. In summary, potential GHG emissions from the Proposed Action could result in GHG emissions of 5.09 Mt CO_2e over the life of the lease.

Table 2-15 compares the estimated annual lease sale emissions to existing federal fossil fuel (oil, gas, and coal) emissions, state, and U.S. total GHG emissions.

Table 2-15. Comparison of Lease Sale Emissions to Other Sources (megatonnes)

Reference	Mt CO_2e * (per year)	Maximum Year Percentage of Reference
Lease sale emissions (maximum year)	0.054	–
New Mexico onshore federal (oil and gas) †	326.00	0.164%
U.S. onshore federal (oil and gas) †	542.06	0.099%
U.S. federal-all (oil and gas) †‡	933.87	0.057%
U.S. federal onshore (oil, gas, and coal) †	1,033.21	0.052%
New Mexico total (all sectors) †	331.85	0.161%
U.S. total	6,899.49	0.008%

Source: BLM Lease Sale Emissions Tool (BLM 2024b)

* Mt (megatonne) = 1 million metric tonnes. Estimates are based on 100-GWP values.

† Federal values come from Tables ES-1 and ES-2 of the Annual GHG Report.

‡ Includes offshore and onshore oil and gas production.

SOCIAL COST OF GREENHOUSE GASES

The “social cost of carbon,” “social cost of nitrous oxide,” and “social cost of methane” are known collectively as the “social cost of greenhouse gases” (SC-GHGs). These SC-GHGs are estimates of the monetized damages associated with incremental increases in GHG emissions in a given year.

These numbers were monetized; however, they do not constitute a complete cost-benefit analysis, nor do the SC-GHG numbers present a direct comparison with other impacts analyzed in this document. The SC-GHGs measure is provided only to inform agency decision making. For federal agencies, the best currently available estimates of the SC-GHGs are the interim estimates of the social cost of carbon dioxide, methane, and nitrous oxide developed by the Interagency Working Group (IWG) on the SC-GHG.

Table 2-16 presents the SC-GHGs associated with estimated emissions from future potential development of the lease parcels. The IWG's SC-GHG estimates are based on complex models describing how GHG emissions affect global temperatures, sea level rise, and other biophysical processes; how these changes affect society through, for example, agricultural, health, or other effects; and monetary estimates of the market and nonmarket values of these effects. One key parameter in the models is the discount rate, which is used to estimate the present value of the stream of future damages associated with emissions in a particular year. A higher discount rate assumes that future benefits or costs are more heavily discounted than benefits or costs occurring in the present (i.e., future benefits or costs are a less significant factor in present-day decisions). The current set of interim estimates of SC-GHGs have been developed using three different annual discount rates: 2.5%, 3%, and 5% (IWG on Social Cost of Greenhouse Gases 2021).

To address uncertainty in the estimates, the IWG recommends reporting four SC-GHG estimates in any analysis. Three of the SC-GHG estimates reflect the average costs from the multiple simulations at each of the three discount rates. The fourth value represents higher-than-expected economic impacts from climate change. Specifically, it represents the 95th percentile of impacts estimated, applying a 3% annual discount rate for future economic effects. This is a low-probability but high-impact scenario and represents an upper bound of impacts within the 3% discount rate model.

The estimates below follow the IWG recommendations and represent the present value (from the perspective of 2021) of future market and nonmarket costs associated with CO_2, CH_4, and N_2O emissions from potential well development and operations, and potential end use. Estimates are calculated based on IWG estimates of the social cost per metric tonnes of emissions for a given emissions year and BLM's estimates of emissions in each year, rounded to the nearest $1,000.

Table 2-16. SC-GHGs Associated with Future Potential Development.

	Social Cost of GHGs ($)			
	Average Value, 5% Discount Rate	**Average Value, 3% Discount Rate**	**Average Value, 2.5% Discount Rate**	**95th Percentile Value, 3% Discount Rate**
Development and operations	$3,599,000	$13,318,000	$20,047,000	$39,850,000
Mid-stream and end-use	$63,300,000	$231,456,000	$347,875,000	$694,897,000
Total	**$66,899,000**	**$244,774,000**	**$367,922,000**	**$734,747,000**

Source: BLM SC-GHG Emissions Tool (BLM 2023c)

NO ACTION ALTERNATIVE

Under the No Action Alternative, the BLM would not affirm the issuance of the leases. However, in the absence of a Land Use Plan Amendment closing the lands to leasing, they could be considered for inclusion in future lease sales. Although no new GHG emissions would result under the No Action Alternative, the national and global demand for energy is not expected to differ regardless of BLM decision-making.

The BLM does not have a model to estimate energy market substitutions at a spatial resolution needed for this onshore production scenario. Reductions in oil and natural gas produced from federal leases may be partially offset by non-federal production (state and private) in the United States (in which case the indirect GHG emissions would be similar), or overseas, in which case the GHG emissions would likely be higher, to the extent environmental protection requirements for production are less vigorous, and the produced energy would need to be physically transported into the United States. There may also be substitution of other energy resources to meet energy demand. These substitution patterns will be different for oil and gas because oil is primarily used for transportation, while natural gas is primarily used for electricity production and manufacturing, and to a lesser degree by residential and commercial users (EIA 2023b). Coal and renewable energy sources are stronger substitutes for natural gas in electricity generation. The effect of substitution between different fuel sources on indirect GHG emissions depends on the replacement energy source. For example, coal is a relatively more carbon-intense fuel than natural gas and hydroelectricity is the least carbon-intense energy source (see Table 10-3 of the Annual GHG Report [BLM 2023b]). In the transportation sector, alternatives to oil are likely to be less carbon intensive.

Finally, substitution across energy sources or oil and gas production from other locations may not fully meet the energy needs that would otherwise have been realized through production from leases. Price effects may lower the market equilibrium quantity demanded for some fuel sources. This would lead to a reduction in indirect GHG emissions. These three effects are likely to occur in some combination under the No Action Alternative, but the relative contribution of each is unknown. Regardless, GHG emissions under the No Action Alternative are not expected to be zero.

2.2.2.3 *Cumulative Effects*

The analysis of GHGs contained in this EA includes estimated emissions from the lease as described above. An assessment of GHG emissions from other BLM fossil fuel authorizations, including coal leasing and oil and gas leasing and development, is included in the Annual GHG Report (BLM 2023b:Chapter 7). The Annual GHG Report includes estimates of reasonably foreseeable GHG emissions related to BLM lease sales anticipated during the fiscal year, as well as the best estimate of emissions from ongoing production, and development of parcels sold in previous lease sales. It is, therefore, an estimate of cumulative GHG emissions from the BLM federal mineral estates based on actual production and statistical trends as they are presently known.

The methodologies used in the Annual GHG Report provide estimates of foreseeable short-term and projected long-term GHG emissions from activities across the BLM's federal mineral estates.
The foreseeable short-term methodology includes a trends analysis of 1) leased federal lands that are held-by-production,[8] 2) approved APDs, and 3) leased lands from competitive lease sales projected to occur over the next annual reporting cycle (12 months). The data is used to provide a 30-year life-of-lease projection of potential emissions from all federal oil and gas activities and potential lease actions over the next 12 months. The projected long-term methodology uses oil and gas production forecasts from the EIA to estimate GHG emissions out to 2050 that could occur from past, present, and future development of federal fluid minerals. For both methodologies, the emissions are calculated using life-cycle-assessment data and emission factors. These analyses are the basis for projecting GHG emissions from lease parcels that are likely to go into production during the analysis period of the Annual GHG Report and represent both a hard look at GHG emissions from oil and gas leasing and the best available estimate of reasonably foreseeable cumulative emissions related to any one lease sale or set of quarterly lease sales that could occur annually across the entire federal onshore mineral estate.

Table 2-17 presents the summation of the 30-year life-of-project emissions estimates for both the short and long term as previously described for each state where federal mineral actions have been authorized.

[8] Held-by-production - A provision in an oil or natural gas property lease that allows the lessee to continue drilling activities on the property as long as it is economically producing a minimum amount of oil or gas. The held-by-production provision thereby extends the lessee's right to operate the property beyond the initial lease term.

The differences between the short- and long-term emissions estimates can be thought of as an approximation of additional leasing that could occur on federal lands and does not take into consideration additional policies, technological advancements in production or end-use efficiency standards, or an accelerated economy-wide transition away from fossil fuel derived energy production. A detailed explanation of the short-term and long-term emissions estimate methodologies are provided in Sections 6.6 and 6.7 of the Annual GHG Report.

Table 2-17. GHG Emissions from Past, Present, and Reasonably Foreseeable Federal Onshore Lease Development (Mt CO_2e)

State	Existing Wells (report year)	Existing Wells (projected)	Approved APDs	New Leasing	Short-Term Foreseeable Totals	Long-Term Projected Totals
Alabama	0.51	7.56	0.00	0.18	7.74	15.28
Alaska	1.31	19.47	23.13	34.70	77.31	39.67
Arizona	0.00	0.00	0.00	0.00	0.00	0.00
Arkansas	0.55	8.72	0.24	0.24	9.19	16.63
California	4.92	67.90	5.93	2.13	75.96	151.15
Colorado	46.16	399.35	30.80	23.95	454.10	1,395.90
Idaho	0.00	0.00	0.00	0.29	0.30	0.01
Illinois	0.01	0.11	0.00	0.02	0.13	0.26
Indiana	0.00	0.00	0.00	0.02	0.02	0.00
Kansas	0.26	3.81	0.00	0.11	3.92	7.80
Kentucky	0.01	0.07	0.00	0.03	0.10	0.25
Louisiana	3.84	48.54	44.95	13.11	106.60	115.95
Maryland	0.00	0.00	0.00	0.00	0.00	0.00
Michigan	0.07	1.36	0.00	0.58	1.94	2.11
Mississippi	0.12	1.59	0.38	0.38	2.35	3.62
Montana	2.52	25.68	0.42	12.63	38.73	77.12
Nebraska	0.02	0.22	0.00	0.03	0.25	0.47
Nevada	0.13	1.01	0.01	0.19	1.22	4.07
New Mexico	326.00	2,318.83	745.21	119.12	3,183.17	9,961.81
New York	0.00	0.01	0.00	0.00	0.01	0.01
North Dakota	33.32	279.03	57.62	3.57	340.22	1,020.91
Ohio	0.40	3.83	0.00	4.64	8.47	12.20
Oklahoma	1.25	12.23	0.95	1.66	14.83	37.81
Oregon	0.00	0.00	0.00	0.12	0.12	0.00
Pennsylvania	0.00	0.06	0.00	0.67	0.72	0.12
South Dakota	0.11	1.77	0.11	0.11	1.98	3.23
Tennessee	0.00	0.00	0.00	0.00	0.00	0.00
Texas	3.31	36.52	19.00	1.97	57.49	99.95
Utah	13.90	175.34	16.33	36.75	228.41	421.63
Virginia	0.01	0.14	0.00	0.03	0.16	0.27

State	Existing Wells (report year)	Existing Wells (projected)	Approved APDs	New Leasing	Short-Term Foreseeable Totals	Long-Term Projected Totals
West Virginia	0.00	0.06	0.00	0.59	0.65	0.14
Wyoming	103.34	920.76	178.16	317.98	1,416.91	3,134.55
Total onshore federal*	**542**	**4,334**	**1,123**	**576**	**6,033**	**16,523**

Source: BLM Annual GHG Report, Section 7 (BLM 2023b).

* Totals have been rounded.

As detailed in the 2022 Annual GHG Report, which is incorporated by reference, the BLM also looked at other tools to inform its analysis, including the Model for the Assessment of Greenhouse Gas Induced Climate Change (MAGICC)[9] (see Section 9.0 of the Annual GHG Report). BLM conducted MAGICC runs evaluating potential contributions to global climate change and related values for two climate change projection scenarios. These two scenarios were chosen because they most closely approximate or frame the desired outcomes of the Paris Climate Accord and would also reflect the greatest contribution as a percent of BLM's authorized cumulative emissions relative to the global emissions levels contained in the scenarios. IPCC's most optimistic scenario evaluates global CO_2 emissions cut to net zero around 2050. This is the only scenario that meets the Paris Agreement's goal of keeping global warming to around 1.5 degrees Celsius (°C) above pre-industrial temperatures. The second "middle of the road" scenario leaves global CO_2 emissions around current levels before starting to fall by 2050 but does not reach net-zero by 2100. In this scenario, temperatures rise 2.7°C by the end of the century. The maximum BLM fossil fuel (oil, gas, and coal) contribution to global temperature increases under these two scenarios is 0.015°C and 0.013°C, respectively.

As this is an assessment of what BLM has projected could come from the entire federal mineral estate, including the projected emissions from the leases, over the next 30 years, the reasonably foreseeable lease emissions contemplated in this EA are not expected to substantially affect the rate of change in climate effects, bring forth impacts that are not already identified in existing literature, or cause a change in the magnitude of impacts from climate change at the state, national, or global scale.

Recent short-term energy outlook (STEO) reports published by the EIA (EIA 2024) predict that the world's oil and gas supply and consumption will increase over the next 18 to 24 months. The STEO projections are useful for providing context for the cumulative discussion as the global forecast models used for the STEO are not dependent on whether the BLM issues onshore leases but are based on foreseeable short-term global supply and demand and include oil and gas development/operations on existing U.S. onshore leases. Recent STEOs include the following projections for the next 2 years:

- U.S. liquid fuels consumption is projected to increase to 20.40 million barrels per day (b/d) in 2024, up from 20.25 million b/d in 2023.
- U.S. crude oil production is expected to average 13.19 million b/d in 2024 and rise to 13.65 million b/d in 2025.
- U.S natural gas consumption is expected to average 89.68 billion cubic feet/day (Bcf/d) in 2024, decreasing slightly to 89.21 Bcf/d in 2025.
- U.S. liquid natural gas exports are expected to increase from 11.9 Bcf/d in 2023 to 12.34 Bcf/d in 2024 and 14.43 Bcf/d in 2025.

[9] https://magicc.org.

- U.S. coal production is expected to total 496.6 million short tons (MMst) in 2024 and 465.8 MMst in 2025 and decrease to 15% of total U.S. electricity generation in 2024 compared to 17% in 2023, driven by the ongoing retirement of coal-fired generating plants.

Generation from renewable sources will make up an increasing share of total U.S. electricity generation, rising from 21% in 2023 to 24% in 2024. Recent events, both domestically and internationally, have resulted in abrupt changes to the global oil and gas supply. EIA studies and recent U.S. analyses (associated with weather impacts) regarding short-term domestic supply disruptions and shortages or sudden increases in demand demonstrate that reducing domestic supply (in the near-term under the current supply and demand scenario) will likely lead to the import of more oil and natural gas from other countries, including countries with lower environmental and emission control standards than the United States (EIA 2024). Recent global supply disruptions have also led to multiple releases from the U.S. Strategic Petroleum Reserve in order to meet consumer demand and curb price surges.

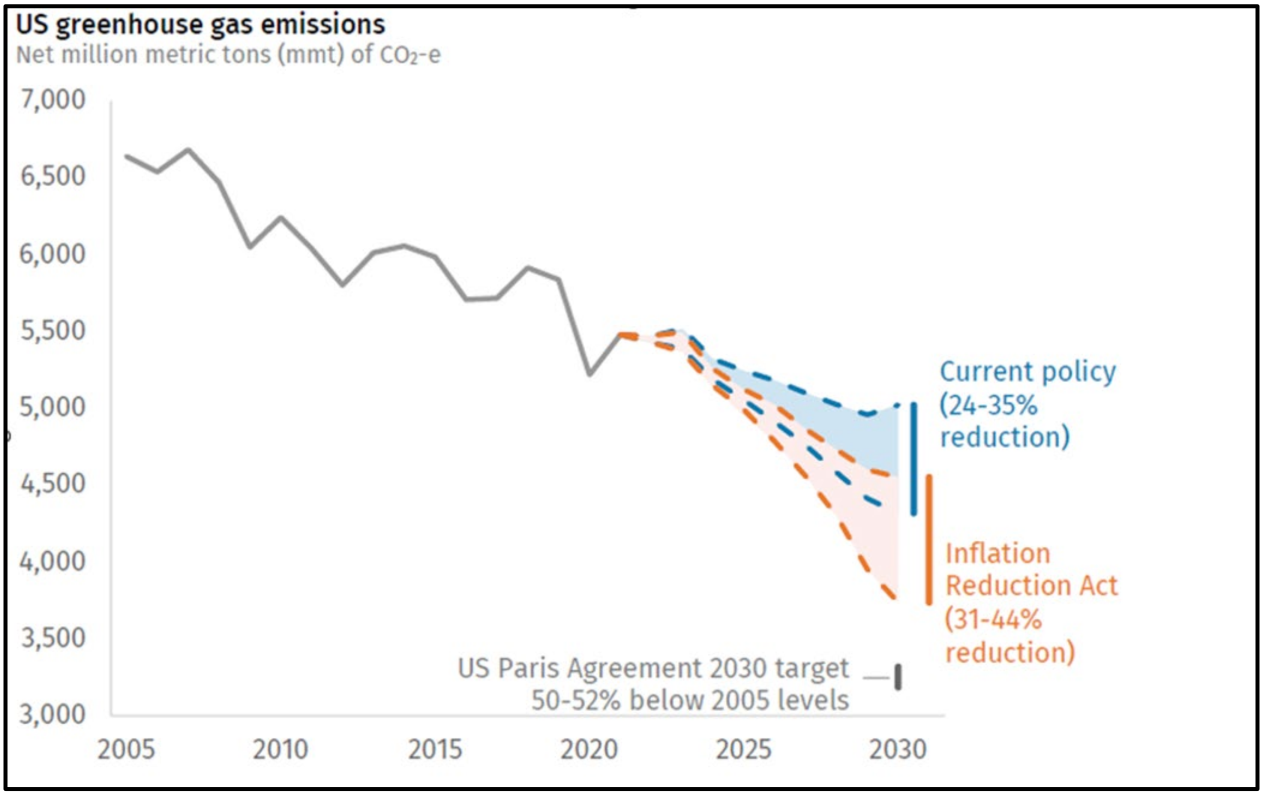
The EIA 2023 Annual Energy Outlook (EIA 2023b) projects energy consumption increases through 2050 as population and economic growth outweighs efficiency gains. As a result, U.S. production of natural gas and petroleum and liquids will rise amid growing demand for exports and industrial uses. U.S. natural gas production increases by 15% from 2022 to 2050. However, renewable energy will be the fastest-growing U.S. energy source through 2050. As electricity generation shifts to using more renewable sources, domestic natural gas consumption for electricity generation is expected to decrease by 2050 relative to 2022. As a result, energy-related CO_2 emissions are expected to fall 25% to 38% below the 2005 level, depending on economic growth factors. Further discussion of past, present, and projected global and state GHG emissions can be found in Chapter 5 of the Annual GHG Report (BLM 2023b).

Executive Order 14008, "Tackling the Climate Crisis at Home and Abroad" (January 27, 2021), directs the executive branch to establish policies or rules that put the United States on a path to achieve carbon neutrality, economy-wide, by no later than 2050. This goal is consistent with IPCC's recommendation to reduce net annual global CO emissions between 2020 and 2030 in order to reach carbon neutrality by mid-century. Federal agencies are still in the process of developing policies that align with a goal of carbon neutrality by 2050. In the short-term, the order has a stated goal of reducing economy-wide GHG emissions by 50% to 52% relative to 2005 emissions levels no later than 2030 (see Figure 2-2).

Carbon budgets estimate the amount of additional GHGs that could be emitted into the atmosphere over time to reach carbon neutrality while still limiting global temperatures to no more than 1.5°C or 2°C above preindustrial levels (see Section 9.1 of the Annual GHG Report [BLM 2023b]). The IPCC Special Report on Global Warming of 1.5ºC is the most widely accepted authority on the development of a carbon budget to meet the goals of the Paris Agreement (IPCC 2020). None of the global carbon budgets or pledges that countries have committed to stay within as part of the Paris Agreement are binding.
At present, no national or federal agency carbon budgets have been established, primarily due to the lack of consensus on how to allocate the global budget to each nation, and as such the global budgets that limit warming to 1.5°C or 2.0°C are not useful for BLM decision making, particularly at the leasing stage, as it is unclear what portion of the budget applies to emissions occurring in the United States.

The CEQ discourages federal agencies from comparing emissions from an action to global or domestic levels as "such comparisons and fractions also are not an appropriate method for characterizing the extent of a proposed actions and its alternatives' contributions to climate change because this approach does not reveal anything beyond the nature of the climate change challenge itself" (CEQ 2023:18). However, stakeholders and members of the public have requested that the BLM consider comparing the estimated federal oil and gas emissions in the context of global carbon budgets. In the interest of public disclosure, Table 9-1 in the Annual GHG Report (BLM 2023b) provides an estimate of the potential emissions associated with federal fossil fuel authorizations in relation to IPCC carbon budgets. Total federal fossil fuel authorizations, including coal, natural gas, and oil, represents approximately 1.37% of the remaining global carbon budget of 380 gigatonnes of CO_2 needed to limit global warming to 1.5°C.

While continued fossil fuel authorizations will occur over the next decade to support energy demand and remain in compliance with the leasing mandates in the Inflation Reduction Act of 2022 (IRA), the EIA International Energy Outlook expects renewable energy consumption to double between 2020 and 2050 and nearly equal liquid fuels consumption by 2050 (EIA 2023c). The United States has committed to the expansion of renewable energy through infrastructure investments in clean energy transmission and grid upgrades included in the Bipartisan Infrastructure Investment and Jobs Act (Public Law No: 117-58) as well as clean energy investments and incentives included in the IRA.



Source: Rhodium Group (2022a, 2022b). The range reflects uncertainty around future fossil fuel prices, economic growth, and clean technology costs. It corresponds with high, central, and low emissions scenarios detailed in Taking Stock 2022 (https://rhg.com/research/taking-stock-2022/). Under the central scenario (not shown), the IRA accelerates emissions reductions to a 40% cut from 2005 levels (BLM 2023b). Emissions presented are in million metric tonnes. Mt (megatonne) = 1 million metric tonnes

Figure 2-2. Projected short-term emissions reductions associated with the IRA.

2.2.2.4 *Emission Control Measures Considered in the Analysis*

The relationship between GHG emissions and climate impacts is complex, but a project's potential to contribute to climate change is reduced as its net emissions are reduced. When net emissions approach zero, the project has little or no contribution to climate change. Net-zero emissions can be achieved through a combination of controlling and offsetting emissions. Emission controls (e.g., vapor recovery devices, no-bleed pneumatics, leak detection and repair, etc.) can substantially limit the amount of GHGs emitted to the atmosphere, while offsets (e.g., sequestration, low carbon energy substitution, plugging abandoned or uneconomical wells) can remove GHGs from the atmosphere or reduce emissions in other areas. Chapter 10 of the Annual GHG Report (BLM 2023b) provides a more detailed discussion of GHG mitigation strategies.

Several federal agencies work in concert to implement climate change strategies and meet U.S. emissions reduction goals all while supporting U.S. oil and gas development and operations. The EPA is the federal agency charged with regulation of air pollutants and establishing standards for protection of human health and the environment. The EPA has issued regulations that will reduce GHG emissions from any development related to the proposed leasing action. These regulations include the NSPS for Crude Oil and Natural Gas Facilities (40 C.F.R. § 60, Subpart OOOOa), Standards of Performance for Crude Oil and Natural Gas Facilities for which Construction, Modification or Reconstruction Commenced After November 15, 2021 (40 C.F.R. § 60, Subpart Okobo) and Waste Emissions Charge for Petroleum and Natural Gas Systems (40 C.F.R. § 99). These regulations impose emission limits, equipment design standards, and monitoring requirements on oil and gas facilities and a waste emissions charge on CH_4 emissions that exceed 25,000 metric tonnes of CO_2e for applicable petroleum and natural gas facilities currently required to report under the GHG Reporting Rule. A detailed discussion of existing regulations and Executive Orders that apply to BLM management of federal lands as well as current federal and state regulations that apply to oil and gas development and production can be found in Chapter 2 of the Annual GHG Report (BLM 2023b).

At the state level, New Mexico's EMNRD published the New Mexico Oil Conservation Division Statewide Natural Gas Capture Requirements (Waste Prevention Rule), NMAC 19.15.27, on May 25, 2001, as part of the New Mexico statewide enforceable regulatory framework to secure reductions in oil and gas sector emissions and to prevent natural gas waste from new and existing sources. Key provisions include prohibition of unnecessary venting and flaring of waste natural gas where it is technically feasible to route the gas to pipeline or to use this gas for some other beneficial purpose (such as on-site fuel consumption). In all cases, operators must flare rather than vent natural gas except where this is technically infeasible or would pose a safety risk. These provisions will reduce VOC emissions due to stringent limitations on natural gas venting (which results in uncombusted VOC emissions). Additionally, it proposes that natural gas be recovered and reused rather than flared, which would result in reductions of VOCs, NO_X, CO, SO_2, GHGs, and particulate matter emissions. The NMED developed the "Oil and Natural Gas Regulation for Ozone Precursors," NMAC 20.2.50, published on July 26, 2022, with an effective date of August 5, 2022. Approximately 50,000 wells and associated equipment will be subject to this regulation. It is anticipated that the regulation will annually reduce VOC emissions by 106,420 tons, NO_X emissions by 23,148 tons, and CH_4 emissions by 200,000 to 425,000 tons. The regulation includes emissions reduction requirements for compressors, engines and turbines, liquids unloading, dehydrators, heaters, pneumatics, storage tanks, and pipeline inspection gauge launching and receiving. A description of federal and state rules and regulations can be found in Section 2 of the Air Resources Technical Report (BLM 2023a), incorporated by reference.

The majority of GHG emissions resulting from federal fossil fuel authorizations occur outside of the BLM's authority and control. These emissions are referred to as indirect emissions and generally occur off-lease during the transport, distribution, refining, and end use of the produced federal minerals. The BLM's regulatory authority is limited to those activities authorized under the terms of the lease, which primarily occur in the "upstream" portions of natural gas and petroleum systems (i.e., the well-development and well-production phases). This decision authority is applicable when development is proposed on public lands and the BLM assesses the specific location, design, and plan of development. In carrying out its responsibilities under NEPA, the BLM has developed BMPs designed to reduce emissions from field production and operations. BMPs may include limiting emissions from stationary combustion sources, mobile combustion sources, fugitive sources, and process emissions that may occur during development of the lease parcel. Analysis and approval of future development may include the application of BMPs within BLM's authority, included as COAs, to reduce or mitigate GHG emissions. Additional measures proposed at the project development stage may be incorporated as applicant-committed measures by the project proponent or added to necessary air quality permits. Additional information on mitigation strategies, including emissions controls and offset options, are provided in Chapter 10 of the Annual GHG Report (BLM 2023b).

CHAPTER 3. CONSULTATION AND COORDINATION

3.1 TRIBAL CONSULTATION AND STATE HISTORIC PRESERVATION OFFICE AND TRIBAL HISTORIC PRESERVATION OFFICE CONSULTATION

Information related to the BLM's consultation and coordination efforts with Tribes, individuals, organizations, and agencies conducted for the proposed leasing actions can be found in Chapter 4 of the Final January 2021 EA. That chapter discloses efforts surrounding Tribal consultation, State Historic Preservation Office consultation, and Tribal Historic Preservation Office consultation. No additional consultation efforts were completed for this supplemental analysis. The BLM will remain available to engage with Tribes and Pueblos and respond to any consultation requests.

3.2 ENDANGERED SPECIES ACT CONSULTATION

As part of this supplemental analysis, the BLM CFO biologists have reviewed the proposed leasing and determined the Proposed Action would comply with threatened and endangered species management guidelines outlined in the 1988 CFO Resource Management Plan as amended in 1997 (Consultation #2-22-96-F-128), in the biological assessment, and in accordance with the requirements of Federal Land Policy and Management Act and NEPA. In April 2008, the BLM PDO Record of Decision Special Status Species Resource Management Plan Amendment and associated September 2006 Biological Assessment (Consultation #22420-2007-TA-0033) amended both of these land use plans in portions of Chaves, Roosevelt, Eddy, and Lea Counties to ensure continued habitat protection of two BLM special-status species: lesser prairie-chicken (LEPC, *Tympanuchus pallidicinctus*) and dunes sagebrush lizard (*Sceloporus arenicolus*).

As part of this supplemental analysis, the BLM completed a review of species listings within the vicinity of the nominated lease sale parcels using the U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation system in April 2024 under Project Codes 2024-0078126 and 2024-0078127 (accessed April 16, 2024). Two species were identified which were not previously analyzed in the January 2021 EA: tri-colored bat (*Perimyotis subflavus*) and monarch butterfly (*Danaus plexippus*). These species have had a change in Endangered Species Act (ESA) status since the original decision was made. Table 3-1 summarizes the potential for these species to occur in the nominated lease sale parcels.

Table 3-1. Suitability Determinations for ESA Species Not Previously Analyzed

Species (*scientific name*) (status)	**Discussion***
Monarch butterfly (*Danaus plexippus*) (federal candidate)	Critical habitat has not been designated for this species. Monarch butterflies can feed on the nectar of many flowering plants in various habitat types (e.g., fields, roadside areas, wetlands, or urban gardens), but they only breed on milkweed (Family Asclepiadaceae) species (USFWS 2022). Given the lack of site-specific flowering plant species data, and the generalist habitat requirements for monarch butterflies, the nominated lease parcels may contain suitable habitat. Site-specific analysis at the lease development stage will provide an additional opportunity to evaluate suitable habitat for this species.

Species (*scientific name*) (status)	**Discussion***
Tricolored bat (*Perimyotis subflavus*) (federally proposed endangered)	Tricolored bats primarily roost among live and dead leaf clusters of live or recently dead deciduous hardwood trees. In addition, tricolored bats have been observed roosting during summer among pine (*Pinus* spp.) needles and eastern red cedar (*Juniperus virginiana*), within artificial roosts like barns, beneath porch roofs, bridges, concrete bunkers, and rarely within caves. During the winter, tricolored bats hibernate in caves and mines; although, in the southern United States where caves are sparse, tricolored bats often hibernate in road-associated culverts, as well as sometimes in tree cavities and abandoned water wells. The tricolored bat has the potential to occur in nominated lease parcels based on the generalist nature of the species and the presence of some human-made structures, although the amount of potentially suitable habitat within the parcels is very limited. Stipulation HQ-TES-1 (formerly called WO-ESA-7 in the January 2021 EA) is attached to the January 2021 lease sale parcels and will provide protections to threatened and endangered species.

* See Appendix B of the January 2021 EA for summaries of stipulations.

In addition, since the original leasing decision was issued in January 2021, the LEPC Southern Distinct Population Segment was listed as endangered under the ESA. LEPC was previously analyzed in Section 3.5.4 of the January 2021 EA. Given the listing of the LEPC under the ESA effective March 27, 2023 (*Federal Register* 87:72674 and 88:73971), the BLM New Mexico State Office coordinated with USFWS to determine if ESA consultation is warranted to address effects to LEPC associated with BLM oil and gas leasing actions. USFWS confirmed that ESA consultation is not warranted for oil and gas leasing actions which are 10 miles or greater from the LEPC estimated occupied range (USFWS Regional Director 2023). For future leasing actions that occur within 10 miles or less of the LEPC estimated occupied range, BLM would initiate Section 7 consultation for potential effects to the species on a case-by-case basis.

None of the nominated lease sale parcels are within the 2022 estimated occupied range for LEPC, or within the 10-mile buffer of the 2022 estimated occupied range. Furthermore, stipulations including SENM-S-22-CSU and SENM-S-54-NSO were attached to some of the parcels through the prior analysis (see EA Section 3.5.4). These stipulations continue to offer adequate protection for the resource given both the recent change in listing and the species' estimated occupied range (EOR). See Appendix B for a map showing the EOR and parcel proximity.

CHAPTER 4. LIST OF PREPARERS

Table 4-1 contains a list of individuals that contributed to preparation of this supplemental analysis.

Table 4-1. List of EA Preparers

Name	**Area of Expertise**	**Organization**
Adam Deppe	Air Quality Specialist	BLM New Mexico State Office
Catherine Brewster	Natural Resource Specialist	BLM New Mexico State Office
Matias Telles	Supervisor Natural Resource Specialist	BLM Carlsbad Field Office
Brianna Zurita, MPP	Associate Project Environmental Planner, Public Involvement Specialist, and Lead Author	SWCA Environmental Consultants
Brittany Sahatjian	Deputy Project Manager and Project Environmental Planner	SWCA Environmental Consultants
Erin Wielenga	Air Quality Specialist	SWCA Environmental Consultants
Jenn Clayton	Project Manager and Principal Natural Resources Team Lead	SWCA Environmental Consultants

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APPENDIX A. BUREAU OF LAND MANAGEMENT SUMMARY OF CUMULATIVE OIL AND GAS HAZARDOUS AIR POLLUTANT ANALYSIS FOR THE PECOS DISTRICT OFFICE

1.0 INTRODUCTION

The National Environmental Policy Act (NEPA), 42 United States Code (U.S.C.) Chapter 55, requires federal agencies to consider the environmental impacts of its actions as a way to help "attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences." 42 U.S.C. § 4331. *See also* 42 U.S.C. § 4321 (statement of Congressional purpose); 42 U.S.C. § 4336e (defining "major federal actions" to which the law applies). The U.S. Court of Appeals for the Tenth Circuit has recognized that NEPA "requires agencies to consider the environmental impact of their actions as part of the decision-making process and to inform the public about these impacts." *Diné Citizens Against Ruining Our Env't v. Haaland*, 59 F.4th 1016, 1025 (10th Cir. 2023) ("*Diné* CARE II"), citing *Citizens' Comm. to Save Our Canyons v. U.S. Forest Serv.*, 297 F.3d 1012, 1021 (10th Cir. 2002). Pursuant to NEPA, the BLM conducts environmental reviews at all stages of its processes leading to the extraction of oil and gas from BLM lands. In *Diné CARE II*, the U.S. Court of Appeals for the Tenth Circuit held that BLM's NEPA analysis was insufficient in relevant part because the analysis "did not account for the cumulative impact to [Hazardous Air Pollutant (HAP)] emissions from the wells. While BLM considered the cumulative impacts of the criteria pollutants from the approximately 3,000 wells, it did not include any analysis of the anticipated HAP emissions from the construction of those wells over a period of years." *Diné CARE II*, 59 F.4th at 1047.[10]

This paper summarizes the actions the BLM has undertaken to address the court's holding in regard to analysis of cumulative HAP emissions and the associated effects on public health from oil and gas leasing and development. Section 2 describes the broad-scale implications of the ruling for BLM oil and gas leasing and development decisions, and the cumulative oil and gas HAPs analysis approach implemented to address the ruling and BLM's obligations under NEPA. Section 3 focuses on the results of the analysis as it pertains to Applications for Permit Drill (APDs) in the BLM New Mexico's Pecos District Office.

2.0 CUMULATIVE HAPS ANALYSIS

The Tenth Circuit Court holding highlighted the need for BLM to take immediate action to develop a cumulative oil and gas HAPs analysis. In formulating a methodology to address the Tenth Circuit concerns, the BLM had an existing blueprint for assessing air quality-related impacts at a regional scale, the recently completed 2032 BLM Regional Air Modeling Study (Ramboll 2023a). This study, which modeled criteria air pollutant concentrations across western states with significant oil and gas development (Figure A-1), is being used to provide the hard look at impacts on air quality and air quality related values from BLM-authorized oil and gas decisions in the Western US. Employing a similar approach, the BLM contracted for a regional modeling study over the same area to assess HAP emissions from BLM-authorized oil and gas development activities (Ramboll 2023b). The model output allows the BLM to compare concentrations of HAPs to calculated risk-based thresholds in order to provide the hard look at the effects on public health required by NEPA.

[10] The federal Clean Air Act defines a Hazardous Air Pollutant as "any air pollutant" of which "emissions, ambient concentrations, bioaccumulation or deposition of the substance are known to cause or may reasonably be anticipated to cause adverse effects to human health or adverse environmental effect." 42 U.S.C. § 7412.

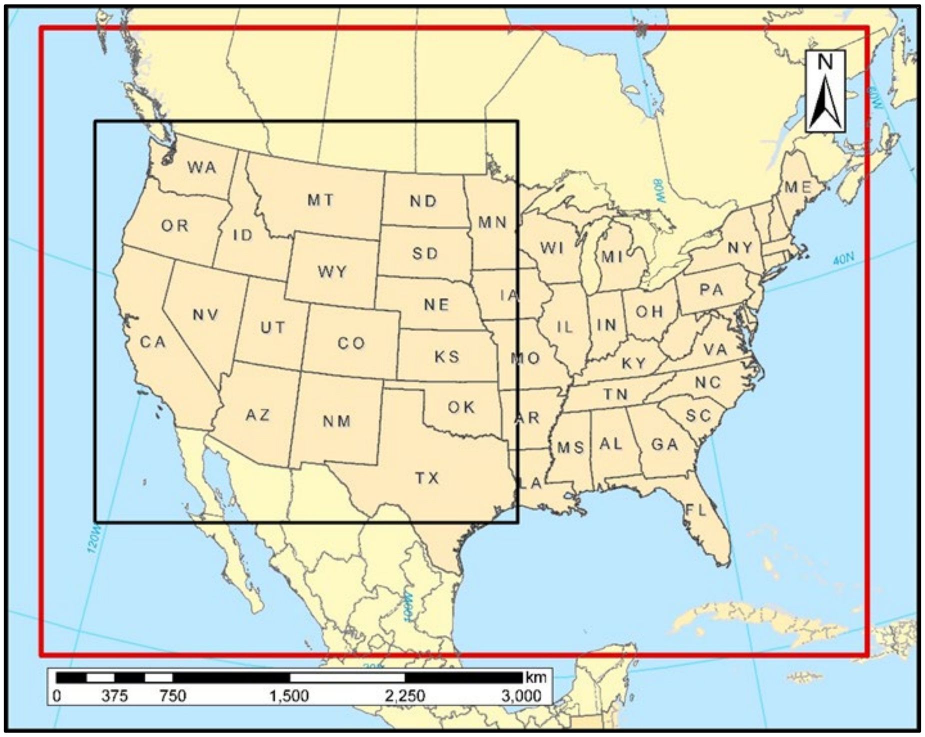

Figure A-1. 36 km resolution continental US and 12 km resolution western US modeling

2.1 CUMULATIVE OIL AND GAS HAPS ANALYSIS

2.1.1 Cumulative Oil and Gas HAPs Modeling Study

In designing the cumulative oil and gas HAPs modeling study (Ramboll 2023b), the BLM was able to rely on its experience related to air quality modeling of oil and gas development activities. As part of the design, the BLM took into consideration the thresholds to compare heath impacts against, as directed by the *Diné CARE II* ruling.

In regard to which HAPs to consider in the analysis, the *Diné CARE II* Court specifically mentioned five HAPs—benzene, toluene, ethylbenzene, mixed xylenes, and n-hexane—as applying to oil and gas development activities based on the National Emission Standards for HAPs (NESHAPs; *see* 43 Code of Federal Regulations [C.F.R.] Part 63). For this study, the BLM chose to include six key HAPs—benzene, toluene, ethylbenzene, xylene, n-hexane, and formaldehyde—because these compounds are common in the oil and gas sector and consistent with regulatory requirements described in the Environmental Protection Agency's (EPA's) New Source Performance Standards, *see* 43 C.F.R. § 60, and NESHAPs.

Oil and gas emissions for the HAPs described above were compiled using the emission inventories developed for the 2032 BLM Regional Air Modeling Study (Ramboll 2023a); these emission inventories were derived using Annual Energy Outlook oil and gas production forecasts for 2032[11]. Using these emission inventories reflected the best available information for projected oil and gas development on BLM-administered lands in the western United States. It also allowed for consistency of modeled sources with the BLM Regional Air Modeling Study (Ramboll 2023a) and enabled the BLM to rapidly deploy a

[11] This approach was used for all BLM field offices except Newcastle and North Dakota, for which new reasonably foreseeable development scenarios had been developed in support of ongoing RMP revision efforts.

solution for providing the cumulative oil and gas HAPs analysis required by the Tenth Circuit and to incorporate this analysis into current BLM resource management planning efforts, namely the North Dakota Resource Management Plan (RMP), which is nearing finalization and for which incorporation of this analysis was deemed critical.

The Council for Environmental Quality (CEQ) regulations define cumulative impacts as the incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable actions regardless of what agency (federal or non-federal) or person undertakes such other actions. 40 C.F.R. § 1508.1(g)(3). Thus, the cumulative effects analysis includes both a geographic (spatial) and a temporal component.

Use of a photochemical grid model provided the spatial component of the analysis. Spatially, the study modeled projected HAP concentrations from existing and reasonably foreseeable new federal and non-federal oil and gas-related emission sources throughout the Western United States using a 12-kilometer modeling domain, the same domain as used in the BLM Regional Air Modeling Study. Use of a regional photochemical model also allows for simulation of potential transport of HAP emissions both within and between airsheds of basins where development of oil and gas is ongoing or forecasted. Within the modeling platform, emissions from point sources were mapped to their geographic coordinates, while emissions from nonpoint sources were allocated by federal and non-federal mineral designation based on spatial surrogates developed for the 2032 BLM Regional Air Modeling Study (Ramboll 2023a). This modeling domain allows the BLM to analyze the effects of projected HAP concentrations on public health across the western states, supporting future oil and gas-related decisions within the Pecos District Office and in field offices throughout the Western United States.

Temporally, the study estimated HAP emissions and modeled HAP concentrations from all existing and reasonably foreseeable federal and non-federal oil and gas-related development anticipated to occur through 2032[12]. Within the modeling platform, existing and reasonably foreseeable HAP emissions were distributed into months, days, and hours using temporal profiles and source/profile cross-references for the oil and gas sector from the EPA's emission modeling platform, an approach that aligns with the methodology EPA uses in its Air Toxics Screening Assessment (EPA 2022a). As described by that document, this approach is also consistent with EPA's Guidelines for Carcinogen Risk Assessment (EPA 2005a) and EPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (EPA 2005b).

2.1.2 Public Health Analysis

The cumulative HAPs modeling study provided modeled oil and gas concentrations of HAPs to compare against health-based risk thresholds. While the *Diné CARE II* ruling referenced only cancer risk, modeled annual concentrations of HAPs were compared to health risk thresholds[13] to assess both cancer risk and noncancer effects from inhalation of the modeled HAPs. Cancer risk was assessed by multiplying the annual modeled concentration of each carcinogenic pollutant by its cancer unit risk estimate found in EPA 2021 and summing the values to determine the long- term cumulative oil and gas individual cancer risk from inhalation of multiple substances.

Noncancer health effects were assessed by calculating the hazard quotient for each HAP (annual modeled concentration divided by the reference concentration for chronic inhalation; EPA 2021) and summing the

[12] EPA's 2016v2 modeling platform (EPA 2022c), the most advanced dataset at the time of model development, includes emissions for the years 2016, 2023, 2026, and 2032. Future year 2032 was used in this modeling assessment.

[13] Since the cumulative HAPs modeling for oil and gas development was performed, the Non- Carcinogenic Chronic Health-Based Threshold concentration for ethylbeneze was updated (see Table 2.

hazard quotient of all six HAPs to determine the overall hazard index. HAP emissions and concentrations as well as associated cancer risk, hazard index, and hazard quotient values by modeling grid cell were used by the BLM to develop an interactive web-based tool[14] that the BLM can utilize in formulating analyses that provide a hard look at the effects on public health from oil and gas leasing and permitting decisions.

3.0 PECOS DISTRICT OFFICE CUMULATIVE OIL AND GAS HAPS ANALYSIS

This report provides a summary of modeling results and risk calculations for the grid cells comprising the geographic area corresponding to the Pecos District Office (Chaves, Curry, DeBaca, Eddy, Guadalupe, Lincoln, Lea, Quay, and Roosevelt Counties, which includes the New Mexico portion of the Permian Basin). This spatial scope of analysis was identified based on the regional nature of air pollution and to facilitate analysis using the best available air quality data, which are generally provided at the county level.

3.1 EMISSIONS INVENTORY DEVELOPMENT

To develop an estimate of HAP emissions in the Pecos District Office needed for the cumulative oil and gas HAPs analysis, oil and gas emissions for the six relevant HAPs were compiled using the emission inventories developed for the circa 2032 BLM Regional Air Modeling Study (Ramboll 2023a).
The emissions inventory for the Pecos District Office was based on Annual Energy Outlook oil and gas projections for the Permian Basin. These projections describe the reasonably foreseeable oil and gas development anticipated to occur within the Permian Basin projected out to 2032, providing the temporal component of the cumulative oil and gas analysis as described by the CEQ regulations. These projections reflect the best currently available information for projected oil and gas development in the Permian Basin (and thus the Pecos District Office).

Emissions of HAPs were distinguished as coming from federal or non-federal sources to allow the BLM to analyze the contribution of impacts from BLM-authorized activities as well as the impacts from cumulative (federal and non-federal) oil and gas activity. In addition, federal emissions were estimated separately for existing oil and gas activity (pre-2020) and new oil and gas activity (2020 to 2032).
A description of the oil and gas-related sources included in the emissions inventory and the methodology for the emissions inventory can be found in Section 2.1 of the BLM Cumulative Hazardous Air Pollutants Modeling Final Report (Ramboll 2023b). As described in Section 2.1.1, above, point and non-point sources were spatially allocated within the modeling domain to model the concentration of HAPs that could be experienced by individuals within each 12-kilometer modeling grid.

3.2 CARCINOGENIC AND NON-CARCINOGENIC RISK CALCULATIONS

As described in Section 2.1.2, above, the cumulative oil and gas HAPs modeling study generated modeled concentrations of HAPs based on projected HAP emissions from federal and non- federal oil and gas activity. These concentrations were used to assess cancer risk and noncancer health effects by comparing the HAP concentrations against health-based thresholds (EPA 2021). As described in Section 3.2 of the BLM Cumulative Hazardous Air Pollutants Modeling Final Report (Ramboll 2023b), inhalation exposure

[14] BLM Integrated Air Resource Tool, HAP Viewer, https://www.blm.gov/content/iart/.

concentration (EC) was assumed to be the same as the modeled ambient air concentrations of HAPs, providing a conservative estimate of risk because no adjustment was made for factors such as time spent indoors (which would result in lower exposure levels).

Risk characterization is a description of the nature and, often, magnitude of human risk, including resulting uncertainties. Risk characterization is accomplished by integrating information from the components of the risk assessment and synthesizing an overall conclusion about risk that is complete, informative, and useful for decision makers (EPA 2000). A "bright line" in risk characterization refers to a threshold value that separates acceptable and unacceptable levels of risk. It is regarded as a clear and unambiguous limit used to determine whether a particular level of exposure to a hazardous substance is safe or not.

Bright lines were not used in the analysis of the cumulative oil and gas HAPs results to determine if a particular risk level is acceptable or not, as no such construct for risk exists within the Clean Air Act framework akin to the national ambient air quality standards (that is, there are no national ambient air quality standards against which to compare modeled HAP concentrations). Rather, values or ranges of values published by EPA (e.g., AirToxScreen [National Air Toxics Assessment] or 40 C.F.R. § 300.430 [Remedial Investigation/Feasibility Study]) were used to provide useful context to risk estimates associated with the cumulative oil and gas HAPs study.

3.2.1 Carcinogenic Risk Calculations

Cancer inhalation risk was calculated for three of the six HAPs—benzene, ethylbenzene, and formaldehyde—by multiplying the annual modeled concentration by the cancer unit risk estimate shown in Table A.1. The other modeled HAPs—toluene, xylenes, and n-hexane—had a cancer risk estimate of zero, indicating that they do not have an associated cancer risk. Total cancer risk was estimated by summing the individual cancer risks for benzene, ethylbenzene, and formaldehyde. As described in the BLM Cumulative Hazardous Air Pollutants Modeling Final Report (Ramboll 2023b), while no explicit risk thresholds are available, EPA uses 1 in 1 million and 100 in 1 million risk for context (EPA 2022).

Table A-1. Cancer Unit Risk Estimates (EPA 2021)

HAP	Cancer Unit Risk Estimate (1/[mg/m^3])
Benzene	0.0000078
Toluene	0
Ethylbenzene	0.0000025
Xylenes	0
n-Hexane	0
Formaldehyde	0.000013

Note: mg/m^3 = milligrams per cubic meter

The most conservative procedure for estimating carcinogenic risk is to assume constant exposure based on a 70-year lifetime exposure. However, it is a common and accepted risk assessment procedure to refine the assumed duration of exposure based upon geographic unit-specific sociological information. EPA exposure assessment guidance states that risk assessments may require adjusted air concentrations be used to represent continuous exposure (EPA 2024).

The adjusted air concentration may be estimated by the following equation:

$$Conc_{ADJ} = Conc_{AIR} \times ET \times \frac{1 \text{ day}}{24 \text{ hours}} \times EF \times \frac{ED}{AT}$$

Where:
$Conc_{ADJ}$ = adjusted concentration of contaminant in air (mg/m^3 or micrograms per cubic meter [µg/m^3])
$Conc_{AIR}$ = Concentration of contaminant in air (mg/m^3 or µg/m^3)
ET = Exposure time (hours/day)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
AT = Averaging time (days)

Because cancer risk is based on a 70-year lifetime exposure, the BLM refined the cancer risk assessments in its interactive web-based tool to present both the upper range of risk based on a 70-year exposure and an adjusted risk based on the average household residency rates for each county in the modeling domain (Lin 2023). Time factors for exposure calculations (from the equation above) used in this study include: 1) exposure time (ET) is assumed to be 24 hours/day, and 2) exposure frequency (EF) (in days/year) is assumed to be 365 days/year. Mathematically, when using the time factors cited above, exposure duration reduces to county residency in years divided by 70 years to yield a simple ratio representing exposure duration (sometimes called the exposure adjustment factor) (AECOM 2017). Adjusted risk can be computed by multiplying the upper range of risk (represented by the assumption of constant exposure of an air concentration of a carcinogenic compound over the 70-year lifetime exposure) by the exposure adjustment factor.

Figure A-2 shows the average householder residency periods for New Mexico by county (see Lin 2023 for data sources). The residency factors for counties within the Pecos District Office are 14.9 years for Chaves, 12.6 years for Curry, 15.0 years for DeBaca, 15.0 years for Eddy, 18.9 years for Guadalupe, 14.0 years for Lea, 14.3 years for Lincoln, 15.6 years for Quay, and 14.1 years for Roosevelt Counties.

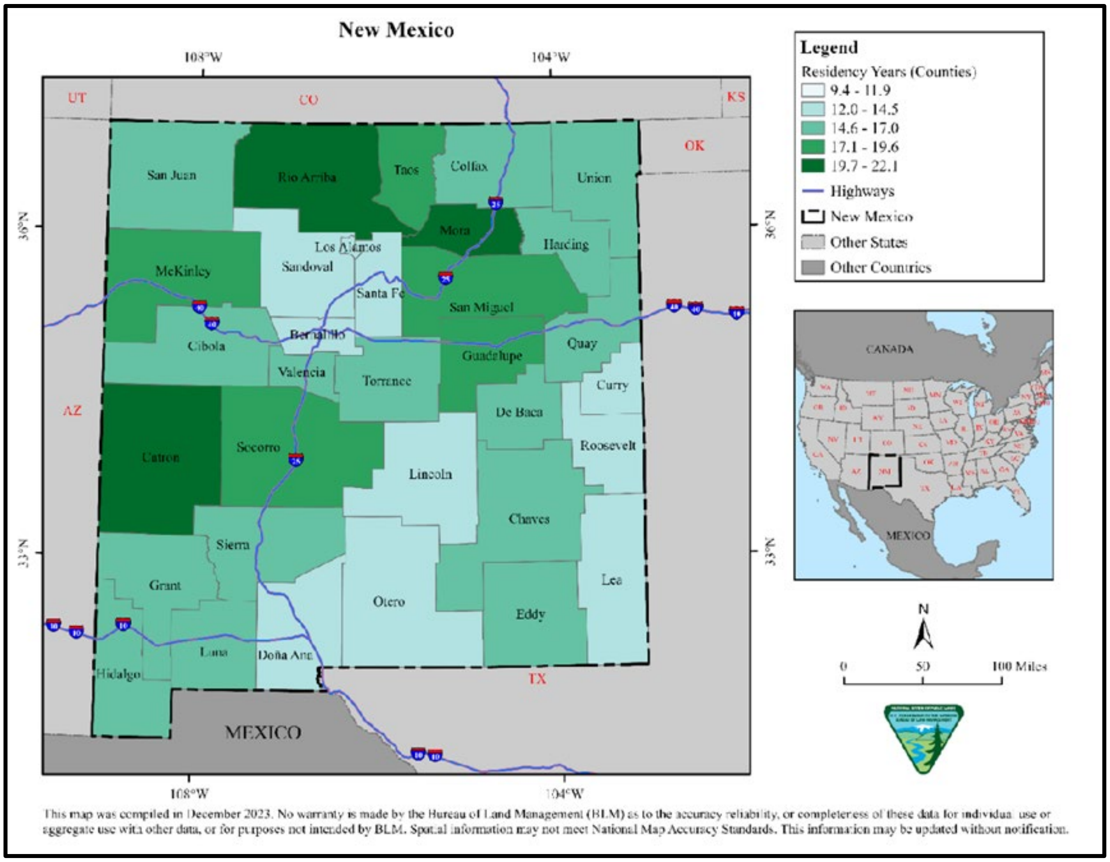

Figure A-2. Residency Periods in Years for Counties in New Mexico

3.2.2 Non-carcinogenic Risk Calculations

A reference concentration for chronic inhalation (RfC) is defined by EPA as the threshold to assess noncancer health effects. RfC values for the HAPs included in this study are shown in Table A-2. Hazard quotients (HQ) were calculated for each HAP by dividing the modeled HAP concentration by its RfC. An HQ value of 1 or less signifies a low likelihood of noncancerous health issues resulting from exposure, while an HQ value exceeding 1 indicates that there is a potential for adverse effects but does not predict the statistical likelihood of them occurring.

Table A-2. Non-Carcinogenic Chronic Health-Based Threshold Concentrations (EPA 2021)

HAP	Non-Carcinogenic Health-Based Chronic Threshold Concentration (mg/m^3)
Benzene	0.03
Toluene	5.0
Ethylbenzene	0.3*
Xylenes	0.1
n-Hexane	0.7
Formaldehyde	0.0098

* The updated threshold for ethylbenzene is shown in EPA 2021 to be 0.26.

Chronic noncancer hazards from multiple HAPs were assessed by summing individual HAP HQs to derive a hazard index (HI). An HI equal to or less than 1 suggests no expected non-cancer-related health issues from exposure. To demonstrate that a pollutant has a significant chronic hazard, it is necessary to establish that the chronic HI exceeds 1 and that at least 10,000 people are exposed to this pollutant.

3.3 SOURCES OF UNCERTAINTY IN HEALTH RISK ESTIMATION

3.3.1 Emissions Quantification and Spatial Allocation

The estimates of HAP emissions from projected oil and gas development were based on the best available information at the time of study development. Sources of uncertainty, which may either overestimate or underestimate HAP emissions that contribute to potential health risk, include: 1) uncertainty in the estimation of emissions, 2) uncertainty in the spatial allocation of emissions from sources that have not yet been developed, and 3) uncertainty in the timing of emission sources.

The emissions presented herein represent a snapshot of estimated emissions for circa 2032 based on the methodology described in Section 3.1. Actual rates of development over time may differ based on market conditions, changes in technology, or a variety of other factors that could result in a greater or lesser amount of oil and gas development than is represented here. Conversely, the emissions in this study may be inherently conservative for the estimated rate of development because emissions from wells are assumed to occur at a steady rate, while actual emissions would likely decline as production decreases over time.

It is important to note that in estimating and simulating the transport and fate of oil and gas emissions from sources not yet realized (i.e., future upstream and midstream sources of emissions associated with the projected increase in development represented by basin-specific reasonably foreseeable development numbers), exact locations of sources cannot be known. As noted in Ramboll 2023b, for future nonpoint oil and gas emissions that are allocated at the county level, spatial surrogates by mineral designation were utilized to spatially allocate emissions to 12-kilometer grid cells. The spatial surrogates were developed using the information provided by BLM as part of the 2032 BLM Regional Air Modeling Study (Ramboll 2023a). These surrogates were assigned to emissions sources based on source classification code[15]. Thus, future year emissions are allocated spatially within a basin according to assumed relationships between upstream and midstream emission sources, which may or may not correspond to a specific location of any wellsite development at the APD stage. Lastly, the timing of well development within an area may differ from what has been modeled, resulting in differing emissions and resultant HAP concentrations.

3.3.2 Health Risk Estimation

The estimates of health risks are based on the current state of knowledge, and the cumulative oil and gas HAPs study followed well established practices for estimating emissions, simulating the transport and fate of these emissions, and estimating public health impacts. However, there is uncertainty associated with the processes of risk assessment.

Sources of uncertainty, which may either overestimate or underestimate risk, include: 1) extrapolation of toxicity data in animals to humans (e.g., in the estimation of the cancer unit risk factors), 2) uncertainty in the estimation of emissions (discussed above), 3) uncertainty in the air dispersion models, and 4) uncertainty in the exposure estimates.

[15] The EPA uses source classification codes (SCCs) to classify different types of activities that generate emissions. Each SCC represents a unique source category-specific process or function that emits air pollutants.

This uncertainty stems from the lack of data in many areas, which necessitates the use of assumptions. Such assumptions are consistent with current scientific knowledge and state-of-the- practice for both air modeling and risk assessment procedures but are often designed to be conservative on the side of health protection in order to avoid underestimation of public health risks. Examples include: 1) use of a simplifying assumption that a person will be exposed to the exact same air concentration of specific hazardous compounds each year for the assumed period of exposure (70 years or less), 2) estimated duration of exposure is either based upon the simplifying assumption of a person residing at the same location for 70 years or use of sociological information to derive average length of residency for geographic units (i.e., county, state, country), 3) simplified exposure duration calculations associated with this study do not take into account more refined exposure adjustments such as number of hours per day a person would be in their home as opposed to being away (e.g., being at a person's place of employment for specified period of hours per day) or the average number of days per year a person would be at their residence, and 4) the simulated air concentrations from this study represent outdoor concentrations air concentrations and do not account for outdoor/indoor air exchange rates, which would attenuate the concentration of a person indoors by a certain amount depending upon air exchange rates, thus this study assumes exposure to the full annual air concentration (dose).

In reality, annual concentrations of compounds will vary from year to year. When using more simple air quality models such as the American Meteorological Society (AMS)/EPA Regulatory Model (AERMOD) model, it is customary to use 5 years of airport meteorological data. Annual average air concentrations are calculated for each year of the 5-year meteorological record. Since risk assessment procedures are often designed to be conservative for protection of public health, choice of the maximum annual average over that 5-year period is deemed acceptable, and risk values are estimated from the maximum annual concentration. However, with this study or when considering EPA's AirToxScreen to help characterize inhalation risk, regional photochemical transport models are used. The complexity and resource-intensive nature of regional photochemical modeling, as compared to AERMOD, effectively prohibits exercise of such models for more than one or several calendar years. Thus, annual concentration from Comprehensive Air Quality Model with extensions (CAMx)/RTRAC used in this study may not be conservative due to the interannual variability of meteorological factors over a wide geographic region, which could result in differences in annual air concentrations from year to year.

3.3.3 Limits on Use of this Information

Due to the uncertainties described above, the risk estimates in this study should not be interpreted as actual rates of disease in the exposed population, but rather as estimates of potential risk, based on current knowledge and a number of assumptions. However, a consistent approach to risk assessment is useful to compare different sources and different substances to characterize potential public health issues that may result from emissions and transport of hazardous air pollutants resulting from oil and gas operations. Additionally, since locations and geographic distributions of emissions from emission sources yet to be developed within specific basins are not known in actuality, risk estimates should largely be used to characterize the range of conditions that could be realized (if full estimated oil and gas development were to occur) across an entire basin airshed as opposed to any specific location within that airshed.

3.4 PECOS DISTRICT OFFICE MODEL RESULTS

The cumulative oil and gas HAPs modeling study provides an assessment of the health effects of HAPs originating from cumulative oil and gas production. A photochemical model is used to estimate the cumulative ambient air concentrations of six HAPs (benzene, toluene, ethylbenzene, xylenes, n-hexane, and formaldehyde) resulting from emissions from federal and non-federal oil and gas sources. These six HAPs were selected by BLM for study because these compounds are common in the oil and gas sector and consistent with regulatory requirements described in the EPA's New Source Performance Standards and NESHAPs.

The BLM's interactive web-based tool was used to extract anticipated emissions for the nine counties that represent the Pecos District Office. The web-based tool, or integrated air resources tool (iART), is a platform that hosts a collection of tools designed to facilitate screening-level assessments of land management projects with the potential to impact air resources. The results of the Western Regional HAPs modeling were incorporated into iART to help streamline the geospatial analysis of cumulative oil and gas HAPs that the BLM may be required to complete for future NEPA projects. As indicated by the data in Table A-3, total federal HAP emissions from oil and gas sources comprise approximately 50 percent of oil and gas HAP emissions in the nine-county planning area.

Table A-3. Circa 2032 Oil and Gas HAP Emissions in the Pecos District Office by County and Mineral Designation

	Hazardous Air Pollutants (tons/year)						
County	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylenes**	**n-Hexane**	**Formaldehyde**	**Total**
Existing Federal							
Chaves	5.36	2.49	0.58	2.27	8.00	24.70	43.40
Curry	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DeBaca	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eddy	103.00	50.60	10.80	40.90	163.00	595.00	963.30
Guadalupe	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lea	64.40	31.80	7.62	27.30	101.00	389.00	621.12
Lincoln	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Quay	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Roosevelt	0.97	0.50	0.10	0.35	2.27	4.72	8.91
Total	*173.73*	*85.39*	*19.10*	*70.82*	*274.27*	*1013.42*	*1636.73*
New Federal							
Chaves	3.80	2.24	0.24	0.40	13.90	7.31	27.89
Curry	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DeBaca	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eddy	40.50	16.30	3.92	15.20	46.20	206.00	328.12
Guadalupe	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lea	104.00	68.70	8.24	14.00	485.00	162.00	841.94
Lincoln	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Quay	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Roosevelt	0.42	0.24	0.03	0.09	1.31	1.38	3.48
Total	*148.72*	*87.48*	*12.43*	*29.69*	*546.41*	*376.69*	*1201.43*
Total Federal (Existing plus New)							
Chaves	9.16	4.73	0.82	2.67	21.90	32.00	71.28
Curry	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DeBaca	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	Hazardous Air Pollutants (tons/year)						
County	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylenes**	**n-Hexane**	**Formaldehyde**	**Total**
Eddy	143.00	67.00	14.80	56.10	209.00	801.00	1290.90
Guadalupe	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lea	169.00	100.00	15.90	41.30	586.00	552.00	1464.20
Lincoln	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Quay	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Roosevelt	1.39	0.74	0.14	0.44	3.58	6.10	12.39
Total	*322.55*	*172.47*	*31.66*	*100.51*	*820.48*	*1391.1*	*2838.77*
Non-Federal							
Chaves	9.15	4.71	0.82	2.66	21.40	32.10	70.84
Curry	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DeBaca	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eddy	159.00	81.80	14.90	49.70	346.00	747.00	1398.40
Guadalupe	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lea	76.10	32.90	8.11	28.80	80.10	456.00	682.01
Lincoln	0.16	0.06	0.02	0.06	0.04	2.45	2.79
Quay	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Roosevelt	71.20	49.40	7.17	17.80	352.00	129.00	626.57
Total	*315.61*	*168.87*	*31.02*	*99.02*	*799.54*	*1366.55*	*2780.61*
Oil and Gas Total							
Chaves	18.30	9.44	1.64	5.33	43.30	64.20	142.21
Curry	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DeBaca	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eddy	302.00	149.00	29.60	106.00	555.00	1550.00	2691.60
Guadalupe	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lea	245.00	133.00	24.00	70.10	667.00	1010.00	2149.10
Lincoln	0.16	0.06	0.02	0.06	0.04	2.45	2.79
Quay	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Roosevelt	72.60	50.10	7.30	18.20	356.00	136.00	640.20
Total	*638.06*	*341.60*	*62.56*	*199.69*	*1621.34*	*2762.65*	*5625.90*

The BLM's interactive web-based tool was used to extract modeled HAP concentrations for the nine counties that represent the Pecos District Office (Table A-4). Concentrations are presented as a range to account for the range of concentrations modeled to occur across each county.

Table A-4. Circa 2032 Oil and Gas HAP Concentrations in the Pecos District Office by County and Mineral Designation

	Hazardous Air Pollutant Concentrations (µg/m³)						
Source	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylene**	**n-Hexane**	**Formaldehyde**	**Total HAPs**
Chaves County							
Existing Federal	0.0004 to 0.0076	0.0001 to 0.0029	<0.0001 to 0.0007	<0.0001 to 0.0028	0.0006 to 0.0129	0.0116 to 0.145	0.0127 to 0.1719
New Federal	0.0003 to 0.0179	<0.0001 to 0.01	<0.0001 to 0.001	<0.0001 to 0.0014	0.0006 to 0.0781	0.0036 to 0.0678	0.0046 to 0.1761
Total Federal	0.0007 to 0.0248	0.0002 to 0.0125	<0.0001 to 0.0016	<0.0001 to 0.0042	0.0012 to 0.0856	0.0154 to 0.2107	0.0175 to 0.3393
Non-Federal	0.0005 to 0.0158	0.0002 to 0.0093	<0.0001 to 0.0009	<0.0001 to 0.0022	0.0011 to 0.0735	0.0117 to 0.206	0.0134 to 0.3077
Total Oil and Gas	0.0011 to 0.032	0.0004 to 0.0153	<0.0001 to 0.0022	0.0001 to 0.0059	0.0023 to 0.0988	0.0271 to 0.4167	0.031 to 0.5707
Curry County							
Existing Federal	0.0004 to 0.0006	0.0001 to 0.0002	Range is <0.0001	<0.0001 to 0.0001	0.0005 to 0.0008	0.0111 to 0.0177	0.0121 to 0.0194
New Federal	0.0006 to 0.001	0.0002 to 0.0004	Range is <0.0001	Range is <0.0001	0.0016 to 0.0029	0.0071 to 0.0094	0.0095 to 0.0137
Total Federal	0.001 to 0.0016	0.0003 to 0.0006	Range is <0.0001	<0.0001 to 0.0002	0.0021 to 0.0037	0.0182 to 0.0271	0.0216 to 0.0332
Non-Federal	0.0011 to 0.002	0.0004 to 0.0009	<0.0001 to 0.0001	0.0001 to 0.0003	0.0027 to 0.0064	0.0187 to 0.0293	0.023 to 0.0389
Total Oil and Gas	0.0021 to 0.0034	0.0007 to 0.0014	0.0001 to 0.0002	0.0002 to 0.0004	0.0048 to 0.0099	0.0369 to 0.0564	0.0448 to 0.0718
DeBaca County							
Existing Federal	0.0004 to 0.0011	0.0001 to 0.0004	Range is <0.0001	<0.0001 to 0.0003	0.0006 to 0.0014	0.0112 to 0.0279	0.0123 to 0.0311
New Federal	0.0004 to 0.0015	0.0001 to 0.0006	Range is <0.0001	<0.0001 to 0.0001	0.001 to 0.0045	0.0055 to 0.0128	0.007 to 0.0195
Total Federal	0.0008 to 0.0024	0.0002 to 0.0009	<0.0001 to 0.0002	<0.0001 to 0.0004	0.0016 to 0.0057	0.0167 to 0.0403	0.0193 to 0.0499
Non-Federal	0.0007 to 0.002	0.0002 to 0.0008	<0.0001 to 0.0001	<0.0001 to 0.0003	0.0014 to 0.0052	0.0138 to 0.0405	0.016 to 0.0488
Total Oil and Gas	0.0015 to 0.0043	0.0004 to 0.0017	<0.0001 to 0.0003	0.0001 to 0.0007	0.0029 to 0.0109	0.0305 to 0.0808	0.0355 to 0.0987
Eddy County							
Existing Federal	0.0004 to 0.0363	0.0001 to 0.0186	<0.0001 to 0.002	<0.0001 to 0.0084	0.0007 to 0.117	0.0121 to 0.375	0.0134 to 0.5573
New Federal	0.0004 to 0.0349	0.0001 to 0.0195	<0.0001 to 0.0019	<0.0001 to 0.0029	0.0007 to 0.152	0.0043 to 0.129	0.0054 to 0.3402
Total Federal	0.0008 to 0.0488	0.0003 to 0.0247	<0.0001 to 0.0033	<0.0001 to 0.0112	0.0014 to 0.1657	0.0164 to 0.421	0.0188 to 0.6746
Non-Federal	0.0006 to 0.0404	0.0002 to 0.0212	<0.0001 to 0.0028	<0.0001 to 0.0088	0.0012 to 0.158	0.0132 to 0.504	0.0152 to 0.7352
Total Oil and Gas	0.0013 to 0.065	0.0004 to 0.0293	<0.0001 to 0.0049	0.0002 to 0.0168	0.0026 to 0.1847	0.0296 to 0.851	0.0341 to 1.1517

	Hazardous Air Pollutant Concentrations (µg/m³)						
Source	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylene**	**n-Hexane**	**Formaldehyde**	**Total HAPs**
Guadalupe County							
Existing Federal	0.0003 to 0.0005	<0.0001 to 0.0001	Range is <0.0001	Range is <0.0001	0.0005 to 0.0007	0.0095 to 0.015	0.0103 to 0.0163
New Federal	0.0004 to 0.0006	0.0001 to 0.0002	Range is <0.0001	Range is <0.0001	0.0008 to 0.0015	0.0048 to 0.0077	0.0061 to 0.0101
Total Federal	0.0007 to 0.0011	0.0002 to 0.0004	Range is <0.0001	<0.0001 to 0.0001	0.0014 to 0.0022	0.0144 to 0.0227	0.0167 to 0.0266
Non-Federal	0.0006 to 0.001	0.0002 to 0.0003	Range is <0.0001	<0.0001 to 0.0001	0.0011 to 0.0022	0.0111 to 0.0213	0.0129 to 0.025
Total Oil and Gas	0.0013 to 0.0021	0.0003 to 0.0007	<0.0001 to 0.0001	0.0001 to 0.0002	0.0024 to 0.0044	0.0255 to 0.044	0.0297 to 0.0517
Lea County							
Existing Federal	0.001 to 0.0133	0.0004 to 0.0064	<0.0001 to 0.0012	0.0002 to 0.0044	0.0018 to 0.0365	0.0263 to 0.282	0.0297 to 0.3438
New Federal	0.0018 to 0.113	0.0006 to 0.0698	0.0001 to 0.0057	0.0002 to 0.0043	0.0021 to 0.58	0.0122 to 0.125	0.017 to 0.8978
Total Federal	0.0034 to 0.1194	0.0016 to 0.0726	0.0002 to 0.0063	0.0004 to 0.0064	0.0079 to 0.5941	0.0393 to 0.392	0.0528 to 1.1908
Non-Federal	0.0024 to 0.0148	0.0009 to 0.008	0.0002 to 0.0012	0.0005 to 0.004	0.0037 to 0.0637	0.0452 to 0.381	0.0529 to 0.4726
Total Oil and Gas	0.0073 to 0.1248	0.003 to 0.0747	0.0005 to 0.0067	0.0011 to 0.0078	0.0141 to 0.6034	0.0889 to 0.773	0.1149 to 1.5904
Lincoln County							
Existing Federal	0.0002 to 0.0009	<0.0001 to 0.0004	Range is <0.0001	<0.0001 to 0.0001	0.0002 to 0.002	0.0063 to 0.0263	0.0068 to 0.0297
New Federal	0.0002 to 0.0005	<0.0001 to 0.0001	Range is <0.0001	Range is <0.0001	0.0005 to 0.0011	0.0028 to 0.0063	0.0035 to 0.008
Total Federal	0.0004 to 0.0014	0.0001 to 0.0005	Range is <0.0001	<0.0001 to 0.0002	0.0007 to 0.0029	0.0092 to 0.0326	0.0104 to 0.0376
Non-Federal	0.0003 to 0.0009	<0.0001 to 0.0003	Range is <0.0001	<0.0001 to 0.0001	0.0006 to 0.0022	0.0079 to 0.0288	0.0088 to 0.0323
Total Oil and Gas	0.0007 to 0.0023	0.0002 to 0.0008	<0.0001 to 0.0001	<0.0001 to 0.0003	0.0013 to 0.0051	0.0171 to 0.0544	0.0193 to 0.0631
Quay County							
Existing Federal	0.0003 to 0.0006	<0.0001 to 0.0002	Range is <0.0001	<0.0001 to 0.0001	0.0004 to 0.0008	0.0091 to 0.0171	0.0097 to 0.0188
New Federal	0.0005 to 0.0008	0.0001 to 0.0003	Range is <0.0001	Range is <0.0001	0.001 to 0.0021	0.0068 to 0.0087	0.0084 to 0.0118
Total Federal	0.0008 to 0.0014	0.0002 to 0.0005	Range is <0.0001	<0.0001 to 0.0002	0.0014 to 0.0028	0.0162 to 0.0258	0.0186 to 0.0306
Non-Federal	0.0008 to 0.0013	0.0002 to 0.0005	Range is <0.0001	<0.0001 to 0.0002	0.0016 to 0.0034	0.0151 to 0.0249	0.0178 to 0.0302
Total Oil and Gas	0.0016 to 0.0026	0.0004 to 0.0009	<0.0001 to 0.0002	0.0001 to 0.0003	0.003 to 0.0062	0.0313 to 0.0507	0.0365 to 0.0609
Roosevelt County							
Existing Federal	0.0005 to 0.0017	0.0002 to 0.0007	<0.0001 to 0.0001	<0.0001 to 0.0004	0.0007 to 0.0041	0.0128 to 0.0372	0.0141 to 0.0443

	Hazardous Air Pollutant Concentrations (µg/m^3)						
Source	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylene**	**n-Hexane**	**Formaldehyde**	**Total HAPs**
New Federal	0.0009 to 0.0022	0.0003 to 0.0011	<0.0001 to 0.0001	<0.0001 to 0.0002	0.0023 to 0.0084	0.0077 to 0.0171	0.0112 to 0.0292
Total Federal	0.0013 to 0.0039	0.0005 to 0.0018	<0.0001 to 0.0002	0.0001 to 0.0006	0.0031 to 0.0122	0.0205 to 0.0543	0.0256 to 0.073
Non-Federal	0.0014 to 0.0915	0.0005 to 0.0572	<0.0001 to 0.0081	0.0002 to 0.0256	0.0035 to 0.476	0.0258 to 0.668	0.0314 to 1.3264
Total Oil and Gas	0.0029 to 0.0948	0.001 to 0.0587	0.0002 to 0.0083	0.0003 to 0.026	0.0067 to 0.4865	0.049 to 0.7037	0.0601 to 1.378

3.5 PECOS DISTRICT OFFICE CUMULATIVE OIL AND GAS CHRONIC CARCINOGENIC AND NON- CARCINOGENIC RESULTS

The modeled oil and gas HAPs long-term (annual) concentrations were assessed for cancer risk and noncancer effects from inhalation for the Pecos District Office for the three modeled oil and gas production source groups (existing federal, new federal, and total non-federal). Lifetime cancer risks for each pollutant have been calculated based on the modeled HAP concentrations. Total lifetime cancer risk from the exposure to three HAPs (benzene, ethylbenzene, and formaldehyde) were calculated by summing the individual cancer risks for each pollutant. Total cancer risk is below 100 in 1 million for context (Table A-5).

Table A-5. Estimated Cancer Risk from Circa 2032 Oil and Gas Production in the Pecos District Office by Mineral Designation

County	**Cancer Risk* from Existing Federal Wells (per million)**	**Cancer Risk* from New Federal Wells (per million)**	**Cancer Risk* from Total Federal Wells (per million)**	**Cancer Risk* from Nonfederal Wells (per million)**	**Cancer Risk* from Cumulative Oil and Gas Production (per million)**	**Adjusted Cancer Risk† From Cumulative Oil and Gas Production (per million)**
Chaves	0.20 to 2.51	0.07 to 1.54	0.26 to 3.95	0.20 to 3.53	0.46 to 7.48	0.10 to 1.59
Curry	0.19 to 0.30	0.13 to 0.18	0.32 to 0.47	0.33 to 0.52	0.64 to 0.99	0.12 to 0.18
DeBaca	0.19 to 0.48	0.10 to 0.24	0.29 to 0.70	0.24 to 0.70	0.52 to 1.40	0.11 to 0.30
Eddy	0.20 to 6.91	0.08 to 2.95	0.28 to 7.57	0.22 to 8.95	0.51 to 15.1	0.11 to 3.24
Guadalupe	0.16 to 0.25	0.09 to 0.14	0.25 to 0.39	0.19 to 0.37	0.44 to 0.76	0.12 to 0.2
Lea	0.45 to 4.65	0.25 to 4.86	0.72 to 7.1	0.79 to 6.46	1.61 to 13.11	0.32 to 2.62
Lincoln	0.11 to 0.44	0.05 to 0.11	0.16 to 0.56	0.14 to 0.48	0.29 to 0.93	0.06 to 0.19
Quay	0.15 to 0.29	0.12 to 0.16	0.28 to 0.45	0.26 to 0.43	0.54 to 0.88	0.12 to 0.20
Roosevelt	0.22 to 0.62	0.15 to 0.32	0.36 to 0.93	0.45 to 12.8	0.87 to 13.45	0.18 to 2.71

*Cancer risk from emissions of benzene, ethylbenzene, and formaldehyde

†Adjusted residency risk based on residency factors by county (14.9 years for Chaves, 12.6 years for Curry, 15.0 years for DeBaca, 15.0 years for Eddy, 18.9 years for Guadalupe, 14.0 years for Lea, 14.3 years for Lincoln, 15.6 years for Quay, and 14.1 years for Roosevelt Counties)

Chronic noncancer hazards from multiple air toxics are assessed by calculating the individual HQ of each pollutant and the overall HI. Table A-6 provides the chronic noncancer HQs and HI for each county in the Pecos District Office. The HI for oil and gas production in each county is below one, indicating no substantial chronic non-cancer health effects from oil and gas production.

Table A-6. Estimated Hazard Quotients and Hazard Index from Circa 2032 Oil and Gas Production in the Pecos District Office by Mineral Designation

	Hazard Quotient (HQ)						Hazard Index (HI)
Source	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylene**	**n-Hexane**	**Formaldehyde**	
Chaves County							
Existing Federal	<0.0001 to 0.0008	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0001	Range is <0.0001	0.0015 to 0.0181	0.0015 to 0.0191
New Federal	<0.0001 to 0.0019	Range is <0.0001	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0004	0.0005 to 0.0085	0.0005 to 0.0109
Total Federal	<0.0001 to 0.0026	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0002	<0.0001 to 0.0004	0.0019 to 0.0263	0.002 to 0.0294
Non-Federal	<0.0001 to 0.0017	Range is <0.0001	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0004	0.0015 to 0.0259	0.0015 to 0.027
Total Oil and Gas	0.0001 to 0.0034	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0003	<0.0001 to 0.0005	0.0034 to 0.0522	0.0035 to 0.0564
Curry County							
Existing Federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0014 to 0.0022	0.0014 to 0.0023
New Federal	<0.0001 to 0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0009 to 0.0012	0.001 to 0.0013
Total Federal	0.0001 to 0.0002	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0023 to 0.0034	0.0024 to 0.0036
Non-Federal	0.0001 to 0.0002	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0024 to 0.0037	0.0025 to 0.0039
Total Oil and Gas	0.0002 to 0.0004	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0046 to 0.0071	0.0049 to 0.0075
DeBaca County							
Existing Federal	<0.0001 to 0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0014 to 0.0035	0.0015 to 0.0036
New Federal	<0.0001 to 0.0002	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0007 to 0.0016	0.0007 to 0.0018
Total Federal	<0.0001 to 0.0003	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0021 to 0.0051	0.0022 to 0.0054
Non-Federal	<0.0001 to 0.0002	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0017 to 0.0051	0.0018 to 0.0053
Total Oil and Gas	0.0002 to 0.0005	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0038 to 0.0101	0.004 to 0.0107
Eddy County							
Existing Federal	<0.0001 to 0.0039	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0004	<0.0001 to 0.0006	0.0015 to 0.047	0.0016 to 0.0516
New Federal	<0.0001 to 0.0037	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0001	<0.0001 to 0.0008	0.0005 to 0.0162	0.0006 to 0.0208

	Hazard Quotient (HQ)						**Hazard Index (HI)**
Source	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylene**	**n-Hexane**	**Formaldehyde**	
Total Federal	<0.0001 to 0.0052	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0005	<0.0001 to 0.0008	0.0021 to 0.0528	0.0021 to 0.0563
Non-Federal	<0.0001 to 0.0043	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0004	<0.0001 to 0.0008	0.0017 to 0.0632	0.0017 to 0.0679
Total Oil and Gas	0.0001 to 0.0069	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0007	<0.0001 to 0.0009	0.0037 to 0.1066	0.0039 to 0.1145
Guadalupe County							
Existing Federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0012 to 0.0019	0.0012 to 0.0019
New Federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0006 to 0.001	0.0006 to 0.0011
Total Federal	<0.0001 to 0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0018 to 0.0029	0.0019 to 0.003
Non-Federal	<0.0001 to 0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0014 to 0.0027	0.0015 to 0.0028
Total Oil and Gas	0.0001 to 0.0002	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0032 to 0.0055	0.0033 to 0.0058
Lea County							
Existing Federal	0.0001 to 0.0014	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0002	<0.0001 to 0.0002	0.0033 to 0.0353	0.0034 to 0.0361
New Federal	0.0002 to 0.012	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0002	<0.0001 to 0.0029	0.0015 to 0.0156	0.0018 to 0.0309
Total Federal	0.0004 to 0.0127	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0003	<0.0001 to 0.003	0.0049 to 0.0491	0.0054 to 0.0511
Non-Federal	0.0003 to 0.0016	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0002	<0.0001 to 0.0003	0.0057 to 0.0477	0.006 to 0.0496
Total Oil and Gas	0.0008 to 0.0133	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0003	<0.0001 to 0.003	0.0111 to 0.0968	0.0121 to 0.1007
Lincoln County							
Existing Federal	<0.0001 to 0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0008 to 0.0033	0.0008 to 0.0034
New Federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0004 to 0.0008	0.0004 to 0.0009
Total Federal	<0.0001 to 0.0002	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0012 to 0.0041	0.0012 to 0.0043
Non-Federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.001 to 0.0036	0.001 to 0.0037
Total Oil and Gas	<0.0001 to 0.0002	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0021 to 0.0068	0.0022 to 0.0071
Quay County							
Existing Federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0011 to 0.0022	0.0012 to 0.0022
New Federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0009 to 0.0011	0.0009 to 0.0012
Total Federal	<0.0001 to 0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.002 to 0.0032	0.0021 to 0.0034

	Hazard Quotient (HQ)						**Hazard Index (HI)**
Source	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylene**	**n-Hexane**	**Formaldehyde**	
Non-Federal	<0.0001 to 0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0019 to 0.0031	0.002 to 0.0033
Total Oil and Gas	0.0002 to 0.0003	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0039 to 0.0064	0.0041 to 0.0067
Roosevelt County							
Existing Federal	<0.0001 to 0.0002	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0016 to 0.0047	0.0017 to 0.0048
New Federal	<0.0001 to 0.0002	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.001 to 0.0022	0.0011 to 0.0024
Total Federal	0.0001 to 0.0004	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0026 to 0.0068	0.0027 to 0.0071
Non-Federal	0.0001 to 0.0097	Range is <0.0001	<0.0001 to 0.0001	<0.0001 to 0.0011	<0.0001 to 0.0024	0.0032 to 0.0837	0.0034 to 0.0955
Total Oil and Gas	0.0003 to 0.0101	Range is <0.0001	<0.0001 to 0.0001	<0.0001 to 0.0011	<0.0001 to 0.0025	0.0061 to 0.0882	0.0066 to 0.1004

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APPENDIX B. LESSER PRAIRIE-CHICKEN ESTIMATED OCCUPIED RANGE MAP

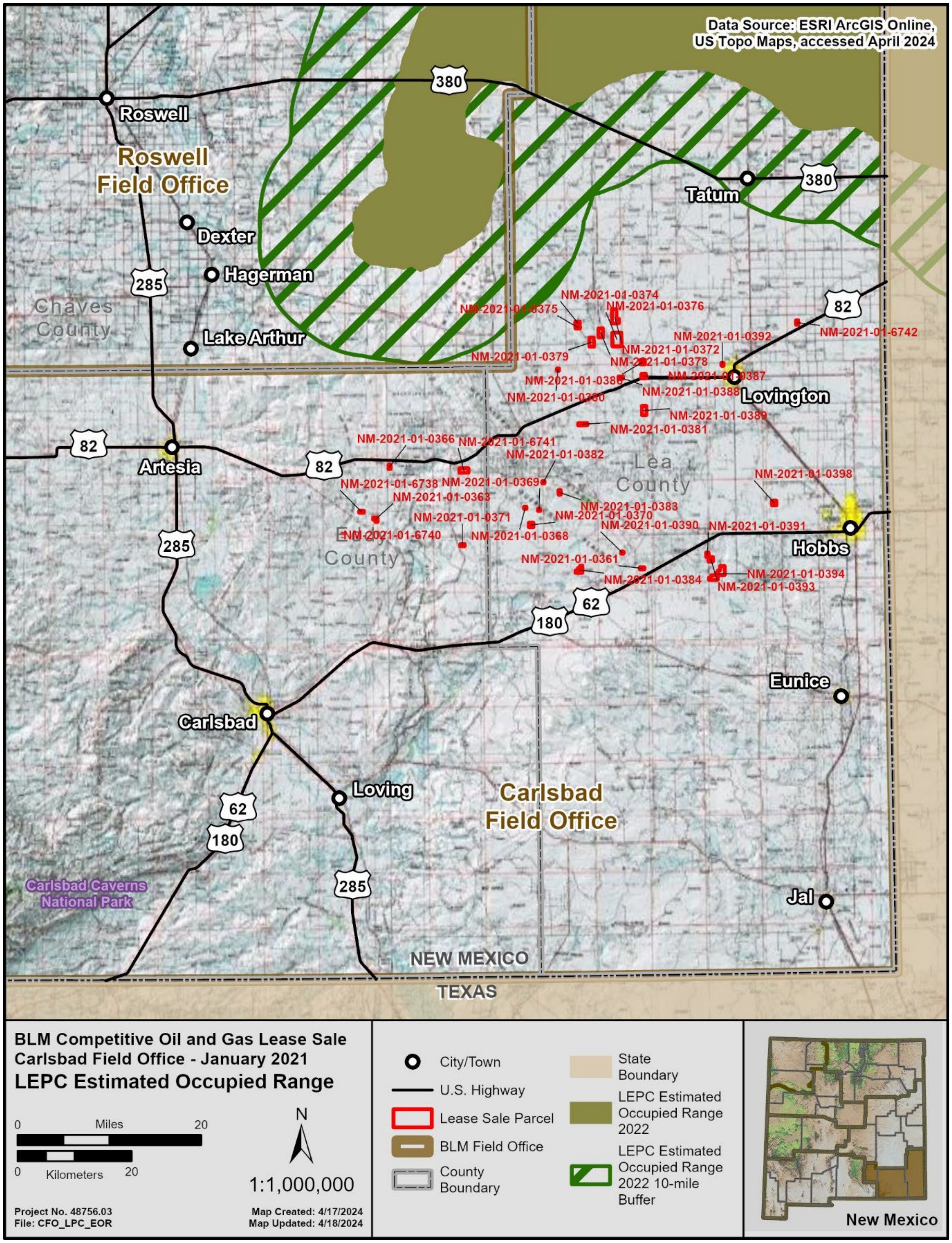

Figure B-1. Lesser prairie-chicken Estimated Occupied Range.