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

Carlsbad Field Office Oil and Gas Lease Sale Environmental Assessment Eddy and Lea Counties, New Mexico January 14, 2021 DOI-BLM-NM-P020-2020-1128-EA

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

$\mu g/m^3$	micrograms per cubic meter
AF	acre-feet
AIB	analyzed in brief
APD	Application for Permit to Drill
APE	area of potential effects
AQI	Air Quality Index
AQRV	Air Quality Related Value
ARTSD	Air Resources Technical Support Document
bbl	barrel(s)
BCR	Bird Conservation Region
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
CAA	Clean Air Act
$CaSO_4 \cdot 2H_2O$	gypsum
CCA	Candidate Conservation Agreement
CCAA	Candidate Conservation Agreements with Assurances
CCNP	Carlsbad Caverns National Park
CEHMM	Center of Excellence for Hazardous Materials Management
CEQ	Council on Environmental Quality
CFO	Carlsbad Field Office
CFR	Code of Federal Regulations
CH_4	methane
CMA	Core Management Area
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COA	condition of approval
CSU	Controlled Surface Use
DAT	deposition analysis threshold
DSL	dunes sagebrush lizard
EA	Environmental Assessment
EMNRD	New Mexico Energy, Minerals and Natural Resources Department
EOI	Expression of Interest
EPA	U.S. Environmental Protection Agency
ERMA	Extensive Recreation Management Area

ESA	Endangered Species Act
EUR	estimated ultimate recovery
FEMA	Federal Emergency Management Agency
FLAG	Federal Land Managers' Air Quality Related Values Work Group
FLPMA	Federal Land Policy and Management Act of 1976
FWFW	Foundation for Western Fish and Wildlife
GHG	greenhouse gas
GIS	geographic information system
GMU	Game Management Unit
GUMO	Guadalupe Mountains National Park
GWP	Global Warming Potential
H_2S	hydrogen sulfide
HA	Habitat Area
HAP	hazardous air pollutant
HUC	hydrologic unit code
IPA	Isolated Population Area
IPaC	Information for Planning and Consultation
IPCC	Intergovernmental Panel on Climate Change
IWG	Interagency Working Group on Social Cost of Carbon, United States Government
kg/ha/yr	kilogram per hectare per year
km	kilometer(s)
LNB	low-NO_x burner
LOC	level of concern
LPC	lesser prairie-chicken
LWC	land with wilderness characteristics
m	meter(s)
mcf	thousand cubic feet
MCM	Menu of Control Measures
MLA	Mineral Leasing Act of 1920
MMT	million metric tons
N/A	not applicable
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NADP	National Atmospheric Deposition Program
NAGPRA	Native American Graves Protection and Repatriation Act
NATA	National Air Toxics Assessment
NEI	National Emissions Inventory

NEPA	National Environmental Policy Act of 1969
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NHD	National Hydrography Dataset
NHPA	National Historic Preservation Act of 1966
NMAAQS	New Mexico Ambient Air Quality Standards
NMAC	New Mexico Administrative Code
NMCRIS	New Mexico Cultural Resource Information System
NMDGF	New Mexico Department of Game and Fish
NMED	New Mexico Environment Department
NMOCD	New Mexico Oil Conservation Division
NMPM	New Mexico Principal Meridian
NMSO	New Mexico State Office
NO_2	nitrogen dioxide
NO_x	nitrogen oxide(s)
NORM	naturally occurring radioactive material
NPS	National Park Service
NRHP	National Register of Historic Places
NSO	No Surface Occupancy
NSPS	New Source Performance Standards
NWI	National Wetlands Inventory
O_3	ozone
OFO	Oklahoma Field Office
OSHA	Occupational Safety and Health Administration
Pb	lead
PBPA	Permian Basin Programmatic Agreement
PDO	Pecos District Office
PFYC	Potential Fossil Yield Classification
PL	Public Law
$PM_{2.5}$	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
POD	plan of development
PPA	Primary Population Area
ppb	parts per billion
ppm	parts per million
PRRC	Petroleum Recovery Resource Center
PSD	Prevention of Significant Degradation
RFD	reasonably foreseeable development

RFFA	reasonably foreseeable future action
RMP	resource management plan
RMPA	Resource Management Plan Amendment
SCC	social cost of carbon
SCR	selective catalytic reduction
SHPO	State Historic Preservation Office
SO	Secretarial Order
SO_2	sulfur dioxide
SOPA	Secretary's Potash Area
SQI	Sky Quality Index
SSPA	Sparse and Scattered Population Area
SVR	standard visual range
SWDA	Safe Drinking Water Act
SWReGAP	Southwest Regional Gap Analysis Project
TAMU	Texas A&M University
TCP	traditional cultural property
UIC	Underground Injection Control
URS	URS Group Inc.
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	volatile organic compound
VRM	Visual Resource Management
WAFWA	Western Association of Fish and Wildlife Agencies
WESTAR-WRAP	Western States Air Resources Council-Western Regional Air Partnership
WIPP	Waste Isolation Pilot Plant
WO	Washington D.C. Office

CHAPTER 1. INTRODUCTION

1.1 BACKGROUND

This Environmental Assessment (EA) documents the Bureau of Land Management (BLM) Carlsbad Field Office (CFO) review of 32 parcels (5,942.36 acres) nominated for auction in the BLM CFO January 14, 2021 Competitive Oil and Gas Lease Sale (the Proposed Action). All parcels contain federal minerals managed by the BLM. For detailed information on the leasing process, see the following website: https://www.blm.gov/programs/energy-and-minerals/oil-and-gas/leasing/parcel-nominations.

1.2 PURPOSE AND NEED

The BLM's purpose is to respond to Expressions of Interest (EOI) to lease federal oil and gas resources through a competitive leasing process. The need for the action is established by the BLM's responsibility under the Mineral Leasing Act of 1920 (MLA), as amended, to promote the exploration and development of oil and gas on the public domain.

1.3 DECISION TO BE MADE

The BLM Authorized Officer will decide whether or not to lease the nominated lease parcels with or without constraints, in the form of lease stipulations, as provided for in the approved land use plans. Regardless, if the decision is to 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 selectively lease, or to defer parcels, based on the analysis of potential impacts presented in this EA. The Decision Record will identify which parcels, if any, the BLM selected for lease and the rationale for the decision.

1.4 CONFORMANCE WITH BLM LAND USE PLANS, OTHER STATUTES, REGULATIONS, AND PLANS

1.4.1 BLM Land Use Plan Conformance

It is the policy of the BLM as derived from various laws, including the MLA and the Federal Land Policy and Management Act of 1976 (FLPMA), as amended, to promote the exploration and development of oil and gas on the public domain. Additionally, the Federal Onshore Oil and Gas Leasing Reform Act of 1987 states that lease sales shall be held for each State where eligible lands are available at least quarterly and more frequently if the Secretary of the Interior determines such sales are necessary.

Under the FLPMA, the BLM must manage public lands and the resources therein for multiple uses in a way that will best meet the present and future needs of the public, and in accordance with an approved land use plan or resource management plan (RMP). For split-estate lands where the mineral estate is an interest owned by the United States, the BLM has no authority over use of the surface by the surface owner; however, the BLM is required to declare how the federal mineral estate will be managed, including identification of all appropriate lease stipulations (43 Code of Federal Regulations [CFR] 3101.1 and 43 CFR 1601.0-7(b); BLM Handbook H-1601-1 and H-1624-1 [BLM 2005, 2018a]). Specifically, this Proposed Action aligns with the Carlsbad Approved RMP (BLM 1988), as amended (BLM 1997a, 2008a).

All nominated lease parcels fall within areas that are open to leasing under the RMP indicated above, as amended. All nominated lease parcels are subject to certain Controlled Surface Use (CSU) stipulations on a lease parcel–specific basis. Additionally, one parcel (parcel 370) is entirely subject to No Surface Occupancy (NSO) stipulations (see Appendices A and C), and portions of one parcel (parcel 6741) are subject to NSO stipulations (see Appendices A and C). Lease parcels, lease parcel surface ownership, lease parcel legal descriptions and total acreage, and lease stipulations and notices that apply are detailed in Appendix A. Stipulation and lease notice descriptions are detailed in Appendix C.

1.4.2 Relationship to Statutes, Regulations, Policies, and Other Plans

The BLM is currently revising the RMP for the CFO planning area. Should the BLM finalize this RMP between the lease sale and lease issuance, lease parcels in the CFO planning area would be subject to the lease stipulations adopted in the revised RMP. If new stipulations as a result of finalization of the RMP are added to the lease after the lease sale but prior to lease issuance, the high bidder will be given the opportunity to accept the modified lease or reject it and receive a refund. If the bidder declines the lease terms due to additional or revised stipulation(s), the BLM would refund all monies, including the administrative fee and include the parcel with all the appropriate stipulations in a subsequent sale notice for future auction. In either case, the BLM would update the analysis to reflect the additional or revised stipulation(s). For more information, see *BLM Oil and Gas Adjudication for Competitive Leases*, Handbook 3120-1 (BLM 2013).

Purchasers of oil and gas lease parcels are required to comply with all applicable federal, state, and local laws and regulations, including obtaining all necessary permits prior to any lease development activities. A listing of applicable statutes, regulations, and other plans is provided in Table 1.1.

Table 1.1. Relationship to Statutes, Regulations, Policies, and Other Plans

Relevant Statute, Regulation, or Plan	Relationship to the Proposed Action
Federal Land Policy and Management Act (FLPMA)	The FLPMA established guidelines to provide for the management, protection, development, and enhancement of public lands (Public Law [PL] 94-579). Section 103(e) of FLPMA defines public lands as any lands and interest in lands owned by the United States. For split-estate lands where the mineral estate is an interest owned by the United States, the BLM has no authority over use of the surface by the surface owner; however, the BLM is required to disclose potential impacts connected to the authorization to lease and develop federal mineral estate and to declare how federal mineral estate is managed in the RMP, including identification of all appropriate lease stipulations (43 CFR 3101.1 and 43 CFR 1601.0-7(b); BLM Handbook H-1601.09 and H-1624-1 [BLM 2005, 2018a]).
Mineral Leasing Act (MLA)	The MLA establishes that deposits of oil and gas owned by the United States are subject to disposition in the form and manner provided by the MLA under the rules and regulations prescribed by the Secretary of the Interior, where consistent with FLPMA, the National Environmental Policy Act of 1969, as amended (NEPA; PL 91-90, 42 United States Code [USC] Section 4321 et seq.), and other applicable laws, regulations, and policies.
43 CFR 3100	These regulations govern onshore oil and gas leasing, development, and production of federal minerals.
Federal Onshore Oil and Gas Leasing Reform Act	This act directs the BLM to conduct quarterly oil and gas lease sales whenever eligible lands are available for leasing.
New Mexico Surface Owner Protection Act	This act requires operators to provide the surface owner at least 5 business days' notice prior to initial entry upon the land for activities that do not disturb the surface; and at least 30 days' notice prior to conducting actual oil and gas operations. Included in this policy is the implementation of a Notice to Lessees, a requirement of lessees and operators of onshore federal oil and gas leases within the state of New Mexico to provide the BLM with the names and addresses of the surface owners of those lands where the federal government is not the surface owner, not including lands where another federal agency manages the surface.

Relevant Statute, Regulation, or Plan	Relationship to the Proposed Action
Endangered Species Act (ESA)	The ESA requires all federal departments and agencies to conserve threatened, endangered, and critical and sensitive species and the habitats on which they depend, as well as consult with the U.S. Fish and Wildlife Service on all actions authorized, funded, or carried out by the agency to ensure that the action will not likely jeopardize the continued existence of any threatened and endangered species or adversely modify critical habitat. See the text of stipulation WO-ESA-7 in Appendix C for details.
National Historic Preservation Act (NHPA)	Leasing is considered an undertaking pursuant to 54 USC Section 300101 et seq., commonly known as the National Historic Preservation Act of 1966, as amended (NHPA), and 54 USC Section 306108, commonly known as Section 106 of the NHPA (Section 106). Agencies may follow a phased approach to Section 106 compliance. At the leasing level, existing records reviews and consultation drive identification of historic properties. Class III field inventories are an important part of identification at the lease-development level. See the text of stipulation WO-NHPA in Appendix C for details.
Federal Cave Resource Protection Act	Secures and protects significant caves on federal land for the benefit and enjoyment of all people and directs the Secretary of the Interior to inventory and list significant caves on federal lands. Details regarding general cave management, the significant cave nomination, evaluation, and designation process, and cave and karst resource confidentiality noted within the Federal Cave Resource Protection Act are located in 43 CFR 37 (Cave Management).

1.5 PUBLIC INVOLVEMENT AND ISSUES

1.5.1 Internal Scoping

The BLM CFO interdisciplinary team conducted internal scoping to identify issues, potential alternatives, and data needs by reviewing the leasing actions within the context of the applicable RMP under the National Environmental Policy Act of 1969 (NEPA) framework. Interdisciplinary team meetings were held at the BLM CFO on June 25 and July 8, 2020, as were weekly meetings with additional BLM interdisciplinary team members during the parcel review process. Additionally, other resource-specific meetings with resource specialists were held to aid in refining issues related to the proposed lease sale.

1.5.2 External Scoping

A project summary page for the Carlsbad Field Office January 14, 2021, Competitive Oil and Gas Lease Sale was posted on the BLM's National NEPA Register website (https://eplanning.blm.gov). The nominated lease parcel information was posted on that website for a public scoping period from July 20 to July 31, 2020.

The BLM CFO received four comment letters regarding the CFO January 14, 2021 Competitive Oil and Gas Lease Sale. Concerns and comments presented by the public and non-governmental organizations are summarized below:

- Concerns regarding COVID-19 such as: public participation, oil and gas market conditions, lease option value analysis, and enforcement of environmental laws
- Concerns regarding NEPA adequacy, site-specific impacts, and the underlying RMPs and ongoing Carlsbad RMP Revision
- Concerns regarding compliance with FLPMA and Secretarial Orders 3362, 3347, and 3356, and consultation with New Mexico Department of Game and Fish (NMDGF) and the U.S. Fish and Wildlife Service (USFWS)
- Requests to defer leasing certain parcels

- Concerns regarding air quality, wildlife habitat, special status species, big game migration corridors, vegetation, cave and karst resources, seismicity, water quality and quantity, visual resources, night skies, tourism, orphaned and abandoned wells, human health risks, environmental justice, and recreation
- Concerns regarding Carlsbad Caverns National Park (CCNP) and Guadalupe Mountains National Park (GUMO)
- Concerns regarding climate change, greenhouse gas (GHG) emissions, and methane waste

1.5.3 Draft EA Public Comment and Response

The draft January 14, 2021 Competitive Oil and Gas Lease Sale EA will be made available for a public comment period from September 14 to September 25, 2020. All comments received will be reviewed and analyzed. Substantive comments will be extracted and responded to appropriately.

1.5.4 Public Protest Period

The Competitive Oil and Gas Lease Sale Notice will be made available from November 9 to November 19, 2020. If there are any protests, the BLM shall resolve protests prior to issuing leases, if any nominated lease parcels should be selected for lease by the BLM Authorized Officer.

1.5.5 Issues

The Council on Environmental Quality (CEQ)[1] regulations state: "NEPA documents must concentrate on the issues that are truly significant to the action in question, rather than amassing needless detail" (40 CFR 1500.1(b)). The regulations at 40 CFR 1500.4(g) direct that the scoping process should be used "not only to identify significant environmental issues deserving of study but also to deemphasize insignificant issues narrowing the scope of the [NEPA] process accordingly."

Through scoping, four issues were identified for detailed analysis in this EA:

- How would future potential development of the nominated lease parcels impact air quality (particularly with respect to National Ambient Air Quality Standards [NAAQS] and volatile organic compounds [VOCs]) in the New Mexico portion of the Permian Basin?
- How would future potential development of the nominated lease parcels contribute to greenhouse gas (GHG) emissions?
- How would future potential development of the nominated lease parcels impact surface and groundwater quantity?
- How would future potential development of the nominated lease parcels impact dunes sagebrush lizard (DSL) (*Sceloporus arenicolus*) and lesser prairie-chicken (LPC) (*Tympanuchus pallidicinctus*)?

An additional 26 issues were identified, considered, and analyzed in brief (AIB) by members of the interdisciplinary team in review of the Proposed Action. These issues are presented in Chapter 3, Section 3.4.

[1] References to the CEQ regulations throughout this EA are to the regulations in effect prior to September 14, 2020. The revised CEQ regulations set to become effective September 14, 2020, are not referred to in this EA because the NEPA process associated with the January 2021 lease sale began prior to this date.

The following resources or concerns were determined to not occur in or adjacent to the nominated lease parcels:

- Special designations including Areas of Critical Environmental Concern, Lands with Wilderness Characteristics, Wilderness Study Areas, Wild and Scenic Rivers, National Trails, and Research Natural Areas

CHAPTER 2. PROPOSED ACTION AND ALTERNATIVES

2.1 PROPOSED ACTION

Under the Proposed Action, the BLM would offer for lease federal minerals associated with the 32 nominated lease parcels. Surface management of the 32 nominated lease parcels totaling 5,942.36 acres is included in Table 2.1. Appendix A provides a description of each of the 32 nominated lease parcels. Appendix B contains parcel maps. Appendix C provides a summary of stipulations and lease notices.

While leasing in itself would not result in any oil and gas development or production, future oil and gas development and production is a reasonable outcome of a granted lease right. The following sections outline: 1) the methodology for estimating well number(s), potential production volumes, and surface disturbance associated with the future potential development of the nominated lease parcels, and 2) the process by which a nominated lease parcel would be developed, including resource value concerns addressed through conditions of approval (COAs) at the Application for Permit to Drill (APD) stage.

Under the Proposed Action, the BLM Authorized Officer has the authority to selectively lease, or to defer parcels, based on the analysis of potential impacts presented in this EA.

2.1.1 Methodology for Estimating Number of Oil and Gas Wells and Production Volumes

Estimates for the number of oil and gas wells that could reasonably be developed on these lease sale parcels are derived from the well densities identified in the BLM PDO RFD (Engler and Cather 2012, 2014; herein incorporated by reference). For parcels where this method resulted in fractional values of less than one well per parcel (because of low anticipated drilling rates), the fractional values were adjusted to one well per parcel to provide meaningful inputs to the oil, gas, and water production projections.

To calculate the volumes of oil, natural gas, and water expected to be produced from the parcels, the number of wells (calculated as described above) was multiplied by the estimated ultimate recoveries (EURs) of oil, natural gas, and water per well for a generalized “type well” for the BLM CFO. These EURs are generated by performing decline curve analyses of existing production within the CFO.

The projected number of wells and associated oil, gas, and water production for these parcels are summarized in Table 2.1.

Table 2.1. Estimated Well Count and Production for the Nominated Lease Parcels

Parcel Number (acres)*	Surface Management (acres)*	Total Horizontal Wells	Surface Disturbance (acres)	Oil Production (bbl)	Gas Production (mcf)	Produced Water Production (bbl)
361 (80)	BLM	1	4.5	168,000	979,600	581,400
363 (120)	Private	1	4.5	168,000	979,600	581,400
366 (80)	BLM	1	4.5	168,000	979,600	581,400
368 (40)	BLM (0.2); Private (39.8)	1	4.5	168,000	979,600	581,400
369 (40)	BLM	1	4.5	168,000	979,600	581,400
370 (160)	BLM	1	4.5	168,000	979,600	581,400
371 (80)	BLM	1	4.5	168,000	979,600	581,400
372 (576.72)	State (0.65); Private (576.07)	1	4.5	168,000	979,600	581,400
374 (80)	Private	1	4.5	168,000	979,600	581,400
375 (80)	Private	1	4.5	168,000	979,600	581,400
376 (960.23)	State (1.52); Private (958.71)	1	4.5	168,000	979,600	581,400
378 (320.19)	State (0.65); Private (319.54)	1	4.5	168,000	979,600	581,400
379 (320)	Private	1	4.5	168,000	979,600	581,400
380 (40)	Private	1	4.5	168,000	979,600	581,400
381 (160)	State (3.48); Private (156.52)	1	4.5	168,000	979,600	581,400
382 (42.3)	State (0.01); Private (42.29)	1	4.5	168,000	979,600	581,400
383 (80)	BLM	1	4.5	168,000	979,600	581,400
384 (239.64)	BLM (239.48); Private (0.16)	1	4.5	168,000	979,600	581,400
386 (160)	Private	1	4.5	168,000	979,600	581,400
387 (160)	Private	1	4.5	168,000	979,600	581,400
388 (80)	Private	1	4.5	168,000	979,600	581,400
389 (320)	Private	1	4.5	168,000	979,600	581,400
390 (40)	BLM (39.7); State (0.3)	1	4.5	168,000	979,600	581,400
391 (80)	Private	1	4.5	168,000	979,600	581,400
392 (50.68)	Private	1	4.5	168,000	979,600	581,400
393 (154.57)	Private	1	4.5	168,000	979,600	581,400
394 (718.3)	Private	1	4.5	168,000	979,600	581,400
398 (160.33)	State (0.67); Private (159.66)	1	4.5	168,000	979,600	581,400
6738 (80)	BLM (80)	1	4.5	168,000	979,600	581,400
6740 (40)	BLM (39.3); State (0.7)	1	4.5	168,000	979,600	581,400
6741 (320)	BLM	1	4.5	168,000	979,600	581,400

Parcel Number (acres)*	**Surface Management (acres)***	**Total Horizontal Wells**	**Surface Disturbance (acres)**	**Oil Production (bbl)**	**Gas Production (mcf)**	**Produced Water Production (bbl)**
6742 (80)	Private	1	4.5	168,000	979,600	581,400
Total BLM CFO (5,942.36)	–	**32**	**144**	**5,376,000**	**31,347,200**	**18,604,800**

Note: bbl = barrels; mcf = thousand cubic feet.

* All acreages contained in the EA analysis were calculated using geographic information system (GIS) data sets for resources and parcels which may differ slightly from the acreages contained in legal description here and in Appendix A. Difference in total acres between parcels can vary due to geoprocessing operations where slivers of area are created when two or more data sets intersect. Any inaccuracies are negligible and do not change the overall impact analysis conclusions presented in this EA.

2.1.2 Methodology for Estimating Surface Disturbance

It is unknown when, where, or to what extent any subsequent well sites, roads, and associated infrastructure would be proposed in the event the BLM decides to lease the nominated parcels. Future potential development of the nominated lease parcels could include the following phases (Appendix D provides a summary of the phases of oil and gas development):

- Construction of new access roads or expansion of existing roads
- Pad construction
- Drilling of a well
- Hydraulically fracturing a well
- Installation of pipeline
- Production, including vehicle traffic, hauling of produced fluids such as oil or produced water, compression to move gas through pipeline systems, potential venting from storage tanks, regular well monitoring, and work-over tasks for the life of the well
- Well plugging and abandonment
- Reclamation and remediation

Based on surface disturbance values identified in the RFD (Engler and Cather 2012), supplemented by recent oil and gas development in the BLM CFO, the BLM estimates 4.5 acres of surface disturbance comprising up to two wells on one pad, an access road, and a pipeline corridor. Assuming future potential development of 32 horizontal wells (for methodology for estimating the number of oil and gas wells, see Section 2.1.1), approximately 144 total acres of new surface disturbance is anticipated. Estimated surface disturbance from future potential development on a parcel-by-parcel basis is provided in Table 2.1. Disturbance would remain on the landscape until final abandonment and reclamation of facilities (generally assumed to occur after 20 years). Interim/ongoing reclamation procedures would be used to limit impacts by restoring disturbed areas as soon as they are no longer required for operations.

2.1.3 Process for Future Potential Development of Lease Parcels

The drilling of wells on lease parcels authorized by the BLM is not permitted until the leaseholder submits, and the BLM approves (subsequent to additional site specific NEPA analysis), a complete Application for Permit to Drill (APD) package (Form 3160-3) following the requirements specified under Onshore Oil and Gas Orders listed in 43 CFR 3162 (BLM 2017). Under the authority granted in standard terms and conditions attached to each lease, measures to reduce impacts on or avoid resource values, land

uses, or users would be attached as COAs to the APD. Under 43 CFR 3101-1-2, such reasonable measures may include, but are not limited to, modification to siting or design of facilities, timing of operations, and specification of interim and final reclamation measures. At a minimum, measures shall be deemed consistent with lease rights granted provided that they do not require relocation of proposed operations by more than 200 meters (m); require that operations be sited off the leasehold; or prohibit new surface-disturbing operations for a period in excess of 60 days in any lease year.

2.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, the BLM would not offer the nominated parcels for competitive leasing in the January 14, 2021 Competitive Oil and Gas Lease Sale. As a result, there would not be any development of the parcels at this time. Parcels would have the potential to be nominated again for a future oil and gas lease sale.

CHAPTER 3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

3.1 INTRODUCTION

Chapter 3 contains the impacts analysis related to the issues. Section 3.2 describes the effects of the No Action Alternative for all issues. Section 3.3 presents an overview of past, present, and reasonably foreseeable future actions (RFFAs) that are considered in the cumulative impact analysis. Section 3.4 presents the issues that are analyzed in brief (AIB). Section 3.5 presents the issues that are analyzed in detail.

3.2 NO ACTION ALTERNATIVE FOR ALL ISSUES

Under the No Action Alternative, the BLM would not lease the nominated lease parcels and the existing conditions and trends related to each issue would continue. Potential impacts associated with the Proposed Action would not occur under this alternative, and current land and resource uses would continue. Oil and gas development would continue on leased land surrounding the nominated lease parcels. No natural gas or crude oil from the nominated lease parcels would be produced, and no royalties would accrue to federal or state treasuries. A choice on the part of the BLM not to lease the nominated lease parcels would eliminate 32 oil and gas development opportunities in the BLM CFO. Reducing total oil and gas development opportunities in the area is likely to incrementally reduce local and regional employment and revenue opportunities related to the oil and gas and service support industries over time. This is because the oil and gas sector of the economy relies on both ongoing operational activities (development of existing leases) and new development opportunities (acquisition and development of new leases) to continue to provide local and regional jobs and revenue on a sustained basis. In the 9.3 million-acre Pecos District Office (PDO), there are approximately 7 million acres of federal mineral estate, of which 2.7 million acres fall within the CFO. Thus, overall development of federal fluid minerals comprises approximately 75% of total oil and gas development activities in the PDO; of this total, development of federal fluid minerals within the CFO comprises approximately 39% of all federal oil and gas development activities in the PDO.

3.3 CUMULATIVE IMPACTS SCENARIO

As defined in 40 CFR 1508.7, a cumulative impact is an impact on the environment that results from the incremental impact of the action when combined with the effects of past, present, and reasonably

foreseeable future actions, regardless of which agency (federal or non-federal) or person undertakes such other actions. The following section outlines past, present, and reasonably foreseeable future actions that would affect the same resources as the Proposed Action and are within the temporal and geographic boundaries of the analysis. For the purposes of this analysis, the temporal scope of analysis is the range presented in the reasonably foreseeable development (RFD) scenario (up to 20 years). The geographic scope of analysis (analysis area for cumulative impacts) is the New Mexico portion of the Permian Basin and includes Eddy, Lea, and the majority of Chaves Counties. The total area of the three counties is approximately 9.3 million surface acres. This "tri-county analysis area" includes approximately 7 million acres of federal mineral estate. The Permian Basin has been a producing oil and natural gas field since the early 1900s. New Mexico ranks fifth in the United States in the production of oil (Statista 2019). In 2019, it produced 329,439,684 barrels (bbl) of oil (New Mexico Oil Conservation Division [NMOCD] 2020a). Most of the Permian Basin that is open to oil and gas leasing is already leased for fluid mineral development.

Past and present actions. There is no reliable estimate for past wells that are no longer in use, and were either plugged, reclaimed, and abandoned or in some cases abandoned without full reclamation. The BLM New Mexico State Office (NMSO) has worked with the State of New Mexico, ranchers, industry, and other local partners on a restoration initiative called Restore New Mexico. Since 2005, the initiative has restored over 3 million acres of grasslands, woodlands, and riparian areas across the state that had been degraded by invasive species and woodland encroachment (U.S. Geological Survey [USGS] 2019). This program has also resulted in the reclamation of some oil and gas legacy well pads, roads, and caliche pits within the tri-county analysis area (Carlsbad Soil and Water Conservation District 2019). Other past and present developments within the district include urban development associated with communities such as Artesia, Carlsbad, and Roswell; roads, pipelines, and transmission lines; and surface disturbance associated with potash mining, such as tailings piles and mine development.

According to data provided by the Petroleum Recovery Resource Center (PRRC), there are currently approximately 41,006 active wells (primarily vertical wells) within the analysis area, of which approximately 18,690 are federal (PRRC 2020). The PRRC is a publicly available data resource that has been providing historical oil and gas production data for New Mexico for over 10 years. Oil and gas production data on the PRRC website are provided primarily by the New Mexico Oil Conservation Division and are updated regularly (PRRC 2020). Assuming an average disturbance of 4.5 acres per well, there would be approximately 184,527 acres of existing surface disturbance in the analysis area from all oil and gas well pads and related infrastructure including roads, electric lines, and pipelines. This is approximately 1.98% of the 9.3 million-acre tri-county analysis area, of which approximately 0.90% would be from federal wells.

In total, impacts from past and present actions within the 9.3 million–acre tri-county analysis area, including all disturbance types, is estimated to be approximately 317,000 acres, including past construction of gas plants, potash mines, oil and gas well pads, access roads, transmission lines, and other linear features (BLM 2018b). This is approximately 3.41% of the tri-county analysis area.

RFFAs. The following RFFAs are considered in this cumulative impact scenario:

- **Oil and gas:** An RFD scenario for oil and gas was developed in 2012 and updated in 2014 for the analysis area (Engler and Cather 2012, 2014). The 2012 and 2014 RFD scenario projects that 800 new oil and gas wells would be completed within the analysis area each year for the 20-year scenario (2015–2035), for a total of approximately 16,000 new wells (federal and non-federal). The majority of these wells are expected to be horizontally drilled. New surface disturbance from potential wells in this RFD scenario is estimated at 4.5 acres per well, for a total of approximately 72,000 acres of reasonably foreseeable future surface disturbance.

- **Mining:** Approximately 2,400 acres of surface disturbance is predicted from the proposed Ochoa Mine (BLM 2014).
- **Infrastructure:** Approximately 4,200 acres of surface disturbance from development of transmission lines and pipelines/associated infrastructure (BLM 2018b).
- **Seismic:** Approximately 32,000 acres of short-term disturbance, with reclamation occurring within 3 years (BLM 2018b).
- **Land farms:** Approximately 140 acres of surface disturbance (BLM 2018b).

Grazing, which is currently occurring on 88% of the analysis area, is assumed to continue at existing levels. Restore New Mexico's rehabilitation efforts would be considered a countervailing impact on the landscape as legacy well development is gradually restored. The BLM, and other agencies, would also continue to treat the landscape with prescribed fire, mechanical treatments, and herbicide. Table 3.1 presents a summary of quantifiable surface disturbances associated with past, present, and reasonably foreseeable future actions within the analysis area.

Table 3.1. Past, Present, and Reasonably Foreseeable Future Estimated Landscape Disturbance within the Analysis Area

Analysis Area	**Number of Wells**	**Acreage**
Tri-county analysis area (includes Eddy, Lea, and most of Chaves Counties), which is generally analogous to the New Mexico portion of the Permian Basin	N/A	9,300,000
Cumulative Actions	**Number of Wells**	**Acreage**
Past and present development	41,006	317,000*
Reasonably foreseeable future federal oil and gas development (Engler and Cather 2012, 2014)	16,000	72,000
Other RFFAs (mining, land farms, and other infrastructure)	N/A	38,740
Total	**57,006**	**427,740**
Contribution of future potential development under the Proposed Action	32	144
Percentage contribution of future potential development under the Proposed Action	0.06%	0.03%†

* Includes estimates of existing disturbance from past oil and gas development, as well as non-oil and gas development.

† The analysis contained in this EA generally provides percentage contribution rounded to two decimal points.

3.4 ISSUES ANALYZED IN BRIEF

The CEQ regulations state: "NEPA documents must concentrate on the issues that are truly significant to the action in question, rather than amassing needless detail" (40 CFR 1500.1(b)). The regulations at 40 CFR 1500.4(g) direct that the scoping process should be used "not only to identify significant environmental issues deserving of study but also to deemphasize insignificant issues narrowing the scope of the [NEPA] process accordingly." Following internal and external scoping, 26 issues were identified, considered, and analyzed in brief by members of the interdisciplinary team in review of the Proposed Action. Each of these issues is outlined below with a concise discussion regarding the context and intensity of the impact related to each issue. Stipulations WO-ESA, WO-NHPA, and Lease Notice NM-11-LN would apply to all nominated lease parcels, as well as standard terms and conditions as described in the lease form. For all issues analyzed in brief that follow, it is assumed that cumulative impacts on relevant elements of the human environment that involve landscape disturbance impacts would be consistent with the acreage of cumulative impacts calculations presented in Table 3.1.

AIB-1 Groundwater Quality

How would future potential development of the nominated lease parcels impact groundwater quality?

Leasing and future potential development of the nominated lease parcels would result in oil and gas activities, including well pad construction, drilling, and completion for an estimated 32 wells. All wells would be horizontal wells that would employ standard industry practices related to well completion (i.e., perforation and hydraulic fracturing). Types of chemical additives used in completion activities may include acids, hydrocarbons, thickening agents, gelling agents, lubricants, and other additives that are operator- and location-specific. The largest components in hydraulic fracturing fluid are water and sand.

If the proposed parcels are drilled, a well would most likely pass through usable groundwater aquifers currently or potentially supplying stock, residential, and/or irrigation water. If proper cementing and casing programs are not followed, there may be a loss of well integrity, surface spills, or loss of fluids in the drilling and completion process that would result in large volumes of high concentrations of chemicals reaching groundwater resources. If contamination of usable water aquifers (total dissolved solids greater than 10,000 parts per million [ppm]) from any source occurs, springs and water wells that are sourced from the affected aquifers could be subject to decreased water quality. Per New Mexico Administrative Code (NMAC) 19.15.16, operators are required to seal and isolate strata containing fresh water from oil- and gas-bearing strata (including sealing the annulus). BLM regulations (including those covered under 43 CFR 3160, Onshore Orders 1, 2, and 7; 43 CFR 3162.3-3 and 43 CFR 3162.3-5; NMOCD (NMAC 19.15.26); and the state's primacy agreement under the Safe Drinking Water Act [SWDA]) include requirements for hydraulic fracturing, including casing specifications, monitoring and recording, and management of recovered fluids (wastewater or produced water). The safeguards that are in place to prevent these situations from occurring are responsibilities managed in the Inspection and Enforcement department within the BLM. The BLM's *2019 New Mexico Water Support Document* (BLM 2019b, herein called the Water Support Document and incorporated by reference) contains a detailed summary of the regulatory program associated with hydraulic fracturing and measures to protect groundwater quality.

The 32 nominated lease parcels are within four groundwater basins (Capitan 1965, Lea County 1931, Lea County 1952, and Roswell 1993). In total, the parcel acreage within these groundwater basins is between 0.00003% and 0.19%. Table 3.2 lists groundwater well use and groundwater well totals within or withing 656 feet (200 m) of the nominated lease parcels. For more information regarding livestock wells and range improvements, see AIB-13.

Table 3.2. Summary of Nominated Lease Parcels with Groundwater Wells

Groundwater Well Use	Parcels (number of wells located within each parcel)	Parcels (number of wells located within 656 feet [200 m] of each parcel)
Domestic and/or Livestock	370 (1), 386 (1), and 392 (1)	370 (1), 376 (2), 379 (1), 386 (2), 387 (1), 392 (7), and 393 (2)
Irrigation	379 (2), 386 (4), and 398 (1)	379 (3), 386 (5), 387 (3), 391 (1), 393 (2), and 398 (1)

Additionally, petroleum tank registered sites are located within 0.5 to 2 miles east and south of parcel 293, and within 4 to 20 miles east and southwest of parcel 298. The Lovington Municipal Water Supply drinking water system is located 1.72 miles southeast of parcel 392. One Septic System Groundwater Contamination Site (nitrate) is located 0.7 mile southeast of parcel 394. The Jal Water Well Field is located 39.54 miles southeast of parcel 394. Standard terms and conditions would apply to all parcels,

which allows for siting of wells to minimize potential impacts to existing groundwater wells and groundwater resources.

Protection of groundwater is enforced in concert with the State of New Mexico and any other applicable entities with jurisdiction (e.g., tribal entities or the U.S. Environmental Protection Agency [EPA]), and mitigation of any water contaminating event would occur in addition to the enforcement of applicable regulations. If impacts were to occur, lessees and operators would be obligated by the standard terms of the lease, as well as the approved APD to report, respond to, and mitigate the spill or release. All injection wells permitted by the NMOCD are subject to a surface injection pressure limitation. Wells are required to be equipped with a pressure-limiting device, which ensures that the maximum surface injection pressure is not exceeded (NMOCD 2004). The BLM District Office compliance officers periodically inspect wells and surface facilities to ensure that all wells and related surface facilities are in good repair and leak free (NMOCD 2004). The NMOCD is also responsible for oversight of hydraulic fracturing wastewater pits. NMAC 19.15.17 regulates the use of liners as well as depth restrictions to protect groundwater.

Since the advent of hydraulic fracturing, more than 1 million hydraulic fracturing treatments have been conducted, with one potential documented case of direct groundwater pollution resulting from injection of hydraulic fracturing chemicals used for shale gas extraction (Gallegos and Varela 2015). Past instances of groundwater contamination in the analysis area attributed to well drilling have not been documented. With consideration of the casing and cementing procedures described above, a detailed analysis is not necessary. In addition, the BLM has authority under standard terms and conditions to require additional measures to protect water quality if site-specific circumstances require them. Site-specific mitigation tools would be developed as appropriate for the individual circumstances, including groundwater-quality monitoring studies. 43 CFR 3162.5-2(d) gives the BLM the authority to require an operator to monitor water resources to ensure that the isolation procedures utilized to protect water and other resources are effective.

Finally, spills could also occur that affect groundwater. The Water Support Document (BLM 2019b) notes a total of 1,261 spills in the Permian Basin in 2018. Roughly half of all spills are not recovered, but rather remediated, which may include removal of contaminated soil. However, no spills occurring in the Pecos District were reported as having affected groundwater (BLM 2019b). Should a spill occur, the BLM would work with the NMOCD to immediately remediate spills on BLM lands in accordance with federal and state standards, including NMAC 19.15.29.11. See the Water Support Document (BLM 2019b) for further information on spills.

The cumulative impact scenario in Section 3.3 provides a quantitative overview of cumulative actions within the analysis area. The RFD scenario projects 16,000 new wells over 20 years (Engler and Cather 2012, 2014). These new wells would pose risks to groundwater similar to those discussed above, including potential contamination of freshwater aquifers from well integrity failures, spills, or loss of fluids during the drilling and completion processes. The regulatory program discussed in the Water Support Document (BLM 2019b) and standard terms and conditions would greatly reduce risks, including cumulative impacts, to groundwater from the projected future well development.

AIB-2 Surface Water Quality

How would future potential development of the nominated lease parcels impact watershed hydrology and surface water quality?

The tri-county analysis area encompasses 12 watersheds, as shown by hydrologic unit codes (HUCs). Current surface disturbance of all types within the 9.3 million-acre analysis area is estimated at 317,000 acres (BLM 2018b), and there are approximately 41,006 active well bores of all well types

(PRRC 2020). The total existing surface disturbance comprises about 3.41% of the analysis area. The nominated lease parcels fall within 10 HUC-10 watersheds that collectively total 1,554,923.06 acres. The total lease acreage of the nominated lease parcels (5,942.36 acres) comprises between 0.03% and 1.16% of each HUC-10 watershed. None of the nominated lease parcels contain any Clean Water Act 303(d) Impaired Waters.

Future potential development of the lease parcels would disturb the vegetation, soils, and mineral substrate, which would create dust and increase runoff rates during precipitation events. By increasing runoff and removing vegetation, disturbed areas would become more susceptible to erosion. Soil that is carried downgradient by runoff due to upslope erosion may create sedimentation issues in streams. Impacts would be most likely to occur during construction of stream crossings for access roads and flowlines, and at well pad locations nearest streams. Future potential development of the lease parcels also carries a risk of spills that could result in the delivery of contaminants to surface water depending on the proximity of development activities to surface water and the measures applied to address the possibility of spills reaching surface water bodies.

Based on review of the USGS's National Hydrography Dataset (NHD) (USGS 2020a) and the U.S. Fish and Wildlife Service's (USFWS's) National Wetlands Inventory (NWI) (USFWS 2020b),[2] the nominated lease parcels listed in Table 3.3 collectively include 1.39 miles of ephemeral streams and/or rivers, 23.92 acres of freshwater ponds, 23.47 acres of intermittent lakes and/or ponds, 0.44 acre of perennial lakes and/or ponds, 3.32 acres of riverine wetlands, and 36.18 acres of Federal Emergency Management Agency (FEMA) Zone A mapped floodplains[3] (FEMA 2020).

Table 3.3. Surface Water Feature Impact Summary

Water Feature	Parcel(s) (total parcel acreage, amount of surface water feature(s) within parcel)
Ephemeral Streams and/or Rivers*,†, ‡	394 (718.30 acres, 0.71 mile), 6740 (40 acres, 0.16 mile), 6741 (320 acres, 0.4 mile)
Freshwater Pond†, ‡	372 (576.51 acres, 0.43 acre), 376 (960 acres, 8.38 acres), 386 (160 acres, 3.29 acres), 387 (160 acres, 0.03 acre), 388 (80 acres, 3.15 acres), 389 (320 acres, 8.19 acres), 6741 (320 acres, 0.44 acre)
Intermittent Lake/Pond*	372 (576.51 acres, 0.43 acre), 376 (960 acres, 8.38 acres), 386 (160 acres, 3.29 acres), 387 (160 acres, 0.03 acre), 388 (80 acres, 3.15 acres) 389 (320 acres, 8.19 acres)
Perennial Lake/Pond*	6741 (320 acres, 0.44 acre)
Riverine Wetlands†, ‡	394 (718.30 acres, 1.70 acres), 6740 (40 acres, 0.95 acre), 6741(320 acres, 0.67 acre)
Zone A Mapped Floodplains§	366 (80 acres, 6.15 acres), 6740 (40 acres, 22.01 acres), 6741 (320 acres, 8.02 acre)

Note: See Appendix C for summaries of stipulations and lease notices. Playas have been identified on parcels 372, 375, 376, 378, 381, 386, 387, and 388. Playas have been identified within 200 m of nominated lease parcels 371, 374, 389, 398, and 6740. Stipulation SENM-S-19-CSU is applied to nominated lease parcels 371, 372, 374, 375, 376, 378, 381, 386, 387, 388, 389, 398, and 6740. See AIB-22 for further information regarding playas, including applicable stipulations.

Previously mapped surface water features have been identified based on desktop review analysis of the USGS's National Hydrography Dataset (USGS 2020a) and the USFWS's National Wetlands Inventory (USFWS 2020b). Additional surface water features may be identified during site-specific analysis at the lease development stage, and the lessee would be required to follow applicable standard terms and conditions, as well as COAs as determined by the BLM.

* Source: USGS (2020a).

† Source: USFWS (2020b).

‡ Wetlands may overlap or surround other surface water features depending on site-specific delineation. Acreage of wetlands may therefore be included in other surface water features presented in this table.

§ Source FEMA (2020).

[2] Delineation size of surface water features varies between the NHD and NWI data sets. Site-specific analysis of the nominated lease parcels would identify aquatic features and wetlands at the time of future potential development of the nominated lease parcels.

[3] Zone A floodplains represent 100-year floodplains that have a 1% chance of being inundated in a given year (FEMA 2020).

Future potential development would result in approximately 144 acres of surface disturbance (approximately 2.24% of the total nominated lease parcel acreage). Standard terms and conditions provide the BLM with the authority to move future potential development to avoid adverse impacts to present surface water features and mitigate accelerated soil erosion and sedimentation to water bodies. For further information on measures that may be required, see the Water Support Document (BLM 2019b).
The NMOCD expressly prohibits pollution of any surface or subsurface fresh water from well completion activities, or treatment, transportation, and disposal of produced water, and provides management of hydraulic fracturing operations. Finally, NMAC 19.15.16 contains minimum casing and cementing standards. Site-specific mitigation tools would be developed as appropriate for the individual circumstances and could include surface water monitoring studies. For example, in the event that the process of hydraulic fracturing were to occur in an area that had potential to communicate with water resources, NMAC regulations would apply to ensure that water is not contaminated during the process by requiring the operator to test the water resource before, during, and after operations.

In addition, stipulation SENM-S-18-CSU is applied to parcels 394, 6740, and 6741 which would prohibit development from occurring within 200 m of a 100-year floodplain (see Table A.1 in Appendix A and Appendix C). This stipulation would also provide concomitant protections to other surface water features identified in Table 3.3 if those surface water features are within 200 m of a 100-year floodplain boundary.

Finally, spills could also occur that affect surface water. However, as noted in the Water Support Document (BLM 2019b), none of the 1,261 spills in 2018 in the Pecos District were reported as having affected surface water. The leasing stipulations, the BLM's authority to require additional protective measures, and the low level of surface disturbance relative to the total watersheds (144 acres of 1,554,923.06 acres, or approximately 0.009% of the total watersheds) would all serve to minimize the risk of impacts on watershed hydrology and surface water quality. Should a spill occur, the BLM would work with the NMOCD to immediately remediate spills in accordance with federal and state standards, including NMAC 19.15.29.11. See the Water Support Document (BLM 2019b) for further information on spills.

The cumulative impact scenario in Section 3.3 provides a quantitative overview of cumulative actions within the analysis area. Past, present, and reasonably foreseeable future actions would result in a total of 427,740 acres of surface disturbance, of which the Proposed Action would comprise approximately 0.02% (see Table 3.1). These impacts include similar risks to surface waters from dust deposition, erosion and sedimentation, and spills as discussed above. Leasing stipulations and other laws and regulations placed to reduce watershed impacts would be followed to minimize risk to surface water features and the same spill response and remediation measures described above would also be required for RFFAs. Many of the cumulative adverse impacts resulting from surface disturbances associated with well pads, access roads, and minerals infrastructure would be long term.

AIB-3 Induced Seismicity

How would future potential development of the nominated lease parcels impact the potential for induced seismicity in the Permian Basin?

Leasing and future potential development of the 32 nominated lease parcels would result in oil and gas activities, including well pad construction, drilling, and completion for an estimated 32 wells. Well drilling and completion activities associated with future potential development of the nominated lease parcels are not anticipated to noticeably contribute to induced seismicity in the Permian Basin. This is because hydraulic fracturing is a very minor contributor toward inducing felt earthquakes; even relatively extreme seismic events associated with hydraulic fracturing are well below the damage threshold for modern building codes (Petersen et al. 2018; USGS 2019b). However, disposal of produced water is the primary cause of anthropogenic felt earthquakes in New Mexico.

Approximately 18,604,800 bbl of produced water (581,400 bbl per well) are projected from future potential development of the nominated lease parcels. Assuming a 20-year production time frame, this equates to an average of approximately 77,520 bbl of produced water per month across all parcels. Produced water may be dealt with in the following ways:

- injection into enhanced oil recovery (EOR) injection wells (typically shallower wells drilled into the hydrocarbon producing zone) to enhance oil recovery in producing oil and gas wells,
- disposal in saltwater disposal (SWD) wells (typically deeper wells drilled to depths below the hydrocarbon producing zone),
- disposal in evaporation ponds, or
- reuse in the hydraulic fracturing process elsewhere.

Currently, evaporation ponds are sparingly used for disposal of produced water due to wildlife and habitat disturbance concerns. Reuse of produced water for hydraulic fracturing is also not widespread because the chemical makeup of produced water is often not compatible with hydraulic fracturing procedures. Thus, the majority of produced water ends up in EOR or SWD wells.

As of July 2020, 1,598 EOR wells and 264 active SWD wells are located within 5 miles of the nominated lease parcels. EOR and SWD wells were identified within 5 miles of nominated lease parcels because use and disposal of produced water is likely to occur near development activity. EOR injection wells are discounted in this analysis because they are typically shallower than SWD wells and not generally associated with notable seismic events (Rubinstein and Mahani 2015).

Disposal of a total of 26,752,651 barrels of produced water into 264 active SWD wells within 5 miles of the nominated lease parcels occurred in 2019. This equates to an average of 149,401 total bbl of produced water per SWD well for 2019 (or an average of 12,450 bbl per month per well). Seven of these SWD wells did not receive any produced water for disposal in 2019. For the remaining SWD wells, the minimum disposal amount in 2019 was 4 bbl (API Number 30-01531041). The maximum disposal amount in a single SWD well (API Number 30-025-05270) in 2019 was 5,014,897 bbl. The median injection volume per well in 2019 was 174,657 bbl, and the median injection volume per well per month in 2019 was 14,555 bbl.

Assuming all 18,604,800 bbl of produced water estimated from future potential development of the nominated lease parcels are ultimately, over time, disposed of in the 264 active SWD wells within 5 miles of the nominated lease parcels, it would represent 13.8% of the approximated total injection of produced water over a 20-year period. Depending on the SWD well used for disposal of produced water, the monthly average of 77,520 bbl of produced water projected as a result of future potential development of the nominated lease parcels would result in a monthly increase of approximately 3.5% on top of the approximated monthly average injection volumes for these wells in 2019 (149,401 bbl) (Table 3.4).

Assuming constant injection rates consistent with 2019 total injection volume rates, the projected total disposal volume across all 264 active SWD wells would be 535,053,020 bbl over a 20-year time frame. Assuming all 18,604,800 bbl of produced water estimated from future potential development of the nominated lease parcels are ultimately, over time, disposed of in the 264 active SWD wells within 5 miles of the nominated lease parcels, it would represent 3.5% of the approximated total injection of produced water over a 20-year period. Depending on the SWD well used for disposal of produced water, the monthly average of 77,250 bbl of produced water projected as a result of future potential development of the nominated lease parcels would result in a monthly per SWD well increase of approximately 1,360 bbl (1%) on top of the approximated monthly average injection volumes for these wells in 2019 (149,401 bbl) (see Table 3.4).

Table 3.4. Produced Water Disposal Summary

Active SWD wells within 5 miles of nominated lease parcels in 2019	264 wells
Total injection volume within those wells in 2019	26,752,651 bbl
Lowest well injection volume within those well in 2019	4 bbl
Highest well injection volume within those well in 2019	5,041,897 bbl
Average injection volume per well in 2019	149,401 bbl
Average injection volume per well per month in 2019	12,450 bbl
Median injection volume per well in 2019	174,657 bbl
Median injection volume per well per month in 2019	14,555 bbl
Projected total disposal volume across all 264 active SWD wells assuming 2019 total injection volume is a constant annual disposal rate over a 20-year period	535,053,020 bbl
Total produced water projected from future potential development of the nominated lease parcels	18,604,800 bbl
Percent contribution of future potential development of the nominated lease parcels to total 20-year anticipated disposal in the 264 active SWD wells	3.5%
Monthly produced water projected from future potential development of the nominated lease parcels assuming a 20-year development time frame	77,520 bbl
Total per well projected monthly injection volume from future potential development of the nominated lease parcels (assuming spread between all 264 SWD wells)	1,360 bbl
Total per well projected monthly injection volume (monthly volume from future potential development of the nominated lease parcels + average per well per month injection volume in 2019)	150,761 bbl
Monthly per SWD well percent increase in injection volume from future potential development of the nominated lease parcels	1%

The risk of induced seismicity increases with long-term and high-volume injections into deep wells carried out through SWD (Ellsworth 2013). A combination of many factors is necessary to induce felt earthquakes: the injection rate and total volume injected, the presence of faults that are large enough to produce felt earthquakes, stresses that are large enough to produce earthquakes, and the presence of pathways for the fluid pressure to travel from the injection point to faults (Machette et al. 2000; USGS 2019b). High injection rates of greater than 300,000 bbl per month are much more likely to be associated with earthquakes, and any earthquake within approximately 15 kilometers (km) (9.3 miles) of an active SWD well could be associated with that well (Weingarten et al. 2015).

Depending on the site-specific circumstances, earthquakes of magnitude 2.5 or greater can be felt, whereas earthquakes of lesser magnitude are often imperceptible except with sensitive detection equipment. Within the Permian, an area of increased risk of induced seismicity has been identified in the Dagger Draw Field which has had an increase in seismic events correlated with increased injection activity (Pursley et al. 2013). Between July 2010 and July 2020, 27 earthquakes with a magnitude of 2.5 or greater (minimum 2.5, maximum 3.3) were measured at area seismographs around the Permian Basin in New Mexico (USGS 2020b). Of these 27 earthquakes, one 2.7 magnitude earthquake occurred on October 21, 2019 approximately 26 km (16 miles) northwest of Jal, New Mexico, in the Dagger Draw area.. The location of the seismicity event was within 15 km (9.3 miles) of nine SWD wells (API Numbers 30-025-24459, 30-025-24771, 30-025-27684, 30-025-34577, 30-025-34982, 30-025-36360, 30-025-36425, 30-025-37582, and 30-025-45085). None of the aforementioned SWD wells related to the Dagger Draw Field are within 8 km (5 miles) of the nominated lease parcels and these wells are not likely to be used as disposal sites for the produced water associated with the estimated development of the nominated lease parcels.

Earthquakes within or near the Dagger Draw Field (approximately 15 miles northwest of Carlsbad) are particularly notable because this is the main area of concern for induced seismicity within the Permian Basin. The Dagger Draw Field falls within the Delaware Basin portion of the Permian Basin (Snee and Zoback 2018). The New Mexico Institute of Mining and Technology catalog of earthquakes in the Dagger Draw region shows increasing seismic events with increasing injection activity (Pursley et al. 2013). A normal faulting stress field is observed throughout the Delaware Basin (Snee and Zoback 2018), giving the region a natural tendency toward seismicity. In the past, oil and gas operations have injected produced water into the basal Ellenburger carbonate reservoir, which rests unconformably on the crystalline basement (Zhang et al. 2016). In southeast New Mexico, the Ellenburger carbonate is estimated to reside between 8,760 feet and 9,110 feet below ground surface and to be approximately 400 feet thick (New Mexico Bureau of Mines 1949). High-volume deep injection of wastewater fluid can bring deep formations closer to failure. Large increases in pore pressure can leave formations resting on the crystalline basement susceptible to faulting triggers, such as additional injection activity or shock transmitted from a remote (<300 miles distant) earthquake (Herzog 2014). SWD wells typically inject into the deepest sedimentary formations (EPA 2020a), where the proximity of fluid injection to basement rock makes this activity particularly capable of inducing earthquakes. Unlike the more viscous and ductile mantle, the earth's crust has a brittle structure where naturally occurring stress can accumulate (Ellsworth 2013). Currently within the Permian Basin, none of the active injection wells are injecting into the Ellenburger carbonate reservoir (NMOCD 2020c).

The projected increase of SWD within the 264 SWD wells within 5 miles of the nominated lease parcels is 2%, increasing the total estimated average injection volume to increase to 1,809,132 bbl per well (150,761 bbl per month). However, average and median estimates of increased injection volumes remain below the 300,000 bbl per month level at which the risk of induced seismicity increases. Also, the well with the highest total SWD injection in 2019 (5,014,897 bbl [417,908 bbl per month], API Number 30-025-05270) within five miles of the nominated lease parcels is 81.9 km (50.9 miles) from the Dagger Draw Field (NMOCD 2020a). There are no active SWD wells in the Dagger Draw Field that are within five miles of any nominated lease parcels, thus the associated development is not likely to contribute towards injection activity associated with increased seismicity events in the area.

The BLM's regulations state that "for an injection well proposed on Federal or Indian leases, the operator shall obtain an Underground Injection Control (UIC) permit pursuant to 40 CFR parts 144 and 146 from the Environmental Protection Agency or the State/Tribe where the State/Tribe has achieved "primacy" (BLM 1993). The EPA classifies these wells as Class II injection wells, which are wells used for disposal of fluids associated with the production of oil and natural gas (hydrocarbons); to inject fluids for enhanced oil recovery; or for the storage of liquid hydrocarbons. New Mexico's UIC Program monitors and regulates the injection of fluids into the subsurface. New Mexico regulations set limits on maximum allowable injection pressures and require mechanical integrity testing of the boreholes, pressure monitoring, and reporting. All injection wells permitted by NMOCD are subject to limitations on surface-injection pressure. Wells are required to be equipped with a pressure-limiting device that ensures that the maximum surface injection pressure is not exceeded (NMOCD 2004). Compliance officers from the NMOCD periodically inspect wells and surface facilities to ensure wells and related surface equipment are in good repair and meet regulations.

Based on the New Mexico regulatory program for injection wells, the amount of produced water anticipated from future potential development of the nominated lease parcels, the volume of injection documented for injection wells within 5 miles of the nominated lease parcels, and the current risk of large magnitude earthquakes in the Permian Basin outside of the Dagger Draw Field, leasing and future potential development of the nominated lease parcels are not expected to result in induced seismicity of magnitude 2.5 or greater.

AIB-4 Sensitive Soils

How would future potential development of the nominated lease parcels impact fragile soils and/or soil stability?

Soil movement disrupts the existing structure of the soil horizons, to the depth of disturbance. Soil-forming processes are halted, and compaction of underlying horizons and loss or degradation of soil microbes may occur. These issues are compounded when fragile and/or sensitive soils are present. Fragile soils are soil types that are easily damaged by use or disturbance and/or are those that are difficult to reclaim to pre-disturbance condition. Within the BLM CFO, examples of managed fragile soils include soils with gypsiferous components ("gypsum soils"), biological soil crusts, active sand dunes, and those on slopes greater than 30 percent.

Additionally, sensitive soils may include those that have components which can be characterized as susceptible to compaction or other mechanical damage and/or are highly erodible when disturbed. Surface disturbance of sensitive soils occurring on increased slope profiles has the potential to impact soil stability and may lead to accelerated soil erosion and potential sedimentation to proximal water bodies (see AIB-2 for more information),

Future potential development of the nominated lease parcels would affect the physical and biological integrity of soils. The anticipated surface disturbance associated with lease development of the nominated lease parcels (approximately 144 acres across all parcels) would comprise 0.00001% of the 9.3 million-acre tri-county analysis area (and 0.02% of the total nominated lease parcel acreage of 5,942.36).

The nominated lease parcels do not contain any mapped units of gypsiferous "gypsum" soils (a limited and fragile soil type that is difficult to reclaim to pre-disturbance condition) or slopes greater than 30% (Natural Resources Conservation Service 2020). Active dune fragile soils are found within the following parcels:

- 361 (77.21 acres, 96.47% of total parcel acreage [80]),
- 366 (28.54 acres, 35.66% of total parcel acreage [80]),
- 369 (1.21 acres, 3.02% of total parcel acreage [40]),
- 370 (0.87 acre, 0.54% of total parcel acreage [160]),
- 382 (18.82 acres, 44.45% of total parcel acreage [42.3]),
- 390 (37.84 acres, 94.69% of total parcel acreage [40]), and
- 6741 (66.85 acres, 20.89% of total parcel acreage [320]).

To prevent potential impacts to active dunes fragile soils, stipulation SENM-S-17-CSU is applied to each of these six parcels (361, 366, 369, 382, 390, 6741). This stipulation would not allow surface disturbance on slopes 30% or greater, and occupancy or use of fragile soils would be considered on a case-by-case basis (see Appendix C). Additionally, stipulation SENM-S-54-NSO (see Appendices A and C) is applied entirely to nominated lease parcel 370 and to portions of nominated lease parcel 6741 (see Appendices A and C) for LPC habitat, that may provide protection to sensitive soils if present within LPC management areas.

Site-specific analysis would occur at the lease development level, and the lessee would be required to follow applicable COAs and reclamation measures as determined by the BLM. These may include measures such as topsoil stockpiling and pad placement in respect to topography and other factors to

further mitigate impacts on the physical and biological integrity of soils during the development of a lease.

The cumulative impact scenario in Section 3.3 provides a quantitative overview of cumulative actions within the analysis area. Past, present, and reasonably foreseeable future actions would result in a total of 427,740 acres of surface disturbance, of which the Proposed Action would comprise approximately 144 acres (0.0003% [see Table 3.1]). Sensitive gypsum soils are scattered throughout the analysis area and comprise approximately 156,479 acres, or 0.02%, of the 9.3 million-acre analysis area (BLM 2019b). The potential for adverse impacts on gypsum soils (or other sensitive soils) would depend on site-specific locations.

AIB-5 Vegetation

How would future potential development of the nominated lease parcels impact vegetation?

Surface disturbance associated with oil and gas development would remove surface vegetation, altering the plant community composition, increasing potential for erosion and soil compaction, and increasing the likelihood for the introduction of noxious weeds (see AIB-6). In these arid plant communities, low rainfall (13 inches per year) combined with limited soil organic matter contributes to communities with low disturbance level thresholds and lack of resilience (BLM 2018c). Removal of vegetation may leave segmented plant communities that would not recover to pre-disturbance levels without reclamation measures, which may take years to achieve (BLM 2018b). The nominated lease parcels are located within the following Level IV Ecoregions (Griffith et al. 2006):

- Chihuahuan Deserts: Chihuahuan Desert Grasslands (319.70 acres, parcels 363, 371, 6738, and 6740);
- High Plains: Arid Llano Estacado (3,651.28 acres, parcels 372, 374–376, 378–381, 386–389, 391–393, 398, and 6742); and
- High Plains: Shinnery Sands (1,978.93, parcels 361, 366, 368–370, 382–384, 390, 393, 394, and 6741)

Using land cover data from the Southwest Regional Gap Analysis Project (SWReGAP) (2020), the nominated lease parcels are covered by the land cover vegetation types listed in Table 3.5. It is expected that rare and unique vegetation types (see Table 3.5) can be avoided as standard lease terms and conditions provide the BLM with the authority to determine site-specific vegetation management strategies, including relocating wells up to 656 feet (200 m), at the lease development stage.

Table 3.5. Southwest Regional Gap Analysis Project Land Cover Vegetation Types within the Nominated Lease Parcels

SWReGAP Land Cover Vegetation Types*	Total Acres of Vegetation Type Intersected by Parcels	Parcels within Land Cover Vegetation Types* (percent of parcel containing land cover vegetation type)
Apacherian-Chihuahuan Mesquite Upland Scrub	1,245.25 acres	361 (45.37%), 363 (86.70%), 366 (19.31%), 368 (89.04%), 369 (4.65%), 371 (84.50%), 382 (28.79%), 383 (61.71%), 384 (67.09%), 386 (5.22%), 387 (3.07%), 388 (3.88%), 389 (6.42%), 390 (84.26%), 391 (22.80%), 393 (2.05%), 394 (58.86%), 398 (26.57%), 6738 (100%), 6740 (45.84%), 6741 (9.05%), 6742 (92.88%)
Apacherian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe	9.72 acres	368 (3.20%), 391 (0.29%), 393 (2.84%), 394 (0.52%)

SWReGAP Land Cover Vegetation Types*	**Total Acres of Vegetation Type Intersected by Parcels**	**Parcels within Land Cover Vegetation Types* (percent of parcel containing land cover vegetation type)**
Chihuahuan Creosote Bush, Mixed Desert and Thorn Scrub	220.46 acres	384 (32.03%), 391 (47.89%), 393 (12.13%), 394 (7.30%), 398 (20.86%)
Chihuahuan Mixed Salt Desert Scrub†	2.45 acres	394 (0.34%)
Chihuahuan Sandy Plains Semi-Desert Grassland†	0.48 acre	6741 (0.15%)
Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub†	2.67 acres	383 (3.33%)
Inter-Mountain Basins Semi-Desert Shrub Steppe†	0.64 acre	389 (0.20%)
North American Warm Desert Active and Stabilized Dune†	10.50 acres	368 (7.61%), 6741 (0.38%)
Recently Burned†	1,391.63 acres	372 (31.57%), 376 (78.34%), 378 (57.69%), 379 (77.14%), 387 (16.03%)
Western Great Plains Sandhill Shrubland	788.07 acres	361 (40.13%), 363 (13.30%), 366 (80.79%), 368 (0.18%), 369 (82.75%), 370 (100%), 382 (55.55%), 383 (5.01%), 384 (1.02%), 390 (7.74%), 391 (29.01%), 393 (55.88%), 394 (4.55%), 6740 (53.93%), 6741 (88.75%)
Western Great Plains Shortgrass Prairie	2,284.64 acres	361 (14.51%), 369 (12.60%), 371 (15.51%), 372 (68.43%), 374 (100%), 375 (100%), 376 (21.66%), 378 (42.31%), 379 (22.86%), 380 (100%), 381 (100%), 382 (15.66%), 383 (29.95%), 386 (94.78), 387 (80.91%), 388 (96.12%), 389 (93.38%), 390 (8.32%), 391 (0.02%), 392 (100%), 393 (27.11%), 394 (28.42%), 394 (52.57%), 6741 (1.67%), 6742 (7.12%)
Total	**5,950.27**‡	

* Source: SWReGAP (2020).

† Indicates rare and unique land cover vegetation types. Rare and unique vegetation types were designated based on present vegetation types, which encompass 1% or less of the 9.3 million-acre analysis area (Sandbom 2020; SWReGAP 2020).

‡ All acreages contained in the EA analysis were calculated using geographic information system (GIS) data sets for resources and parcels, which may differ slightly from the acreages contained in legal description here and in Appendix A. Difference in total acres between parcels can vary due to geoprocessing operations where slivers of area are created when two or more data sets intersect. Any inaccuracies are negligible and do not change the overall impact analysis conclusions presented in this EA.

The estimated disturbance from future potential development of the nominated lease parcels is approximately 144 acres (0.00001% of the 9.3 million-acre analysis area; see Table 3.1). There are five land cover vegetation types identified as rare or unique occurring on nine nominated lease parcels (368, 372, 376, 378, 379, 387, 383, 394, and 6741; see Table 3.5). Considered together, all rare and unique[4] vegetation types comprise between 0.15% (parcel 6741) and 78.34% (parcel 376) of these nine nominated lease parcels. There are no stipulations that would prohibit future potential development within the rare or unique land cover types, but this acreage could reasonably be avoided through application of standard terms and conditions.

Stipulation SENM-S-34-CSU is applied to nominated lease parcel 384 and requires that a plan of development (POD) for shinnery oak sand dune habitat suitable for LPC (*Tympanuchus pallidicinctus*) be submitted for the entire lease (see Section 3.5.4 and Appendix C). Additionally, as described in AIB-4, protections to slopes and fragile soils (parcels 361, 366, 369, 382, 390, and 6741) may provide protections

[4] Rare and unique vegetation types were designated based on present vegetation types, which encompass 1% or less of the 9.3 million-acre analysis area (Sandbom 2020; SWReGAP 2020).

to land cover vegetation types found on these nominated lease parcels where they intersect with these ecological features.

The remainder of the identified vegetation types are common throughout the CFO planning areas and the Level III ecoregions. With the avoidance of rare and unique land cover vegetation types described above, it can be reasonably assumed that future potential development is most likely to occur within one or more of these common vegetation types. In the unlikely event the 144 acres of disturbance were to occur in a single common vegetation type, the level of estimated disturbance would not result in a substantial change to the overall characteristics or availability of said vegetation type across the analysis area. Thus, the estimated level of disturbance would not pose a threat to the viability of species composing these communities or ecoregions, nor to any species utilizing common vegetation for habitat.

Under standard terms and conditions, which would apply to all nominated lease parcels, pre-disturbance surveys would be required at the time of the proposed lease development. The surveys would identify occurrence of rare or unique vegetation types, special status plant species, and/or vegetation providing habitat for special status wildlife species for avoidance during project siting and construction (see AIB-8 for more information). The BLM would conduct site-specific evaluations at the lease development stage for any future actions within the lease parcels to determine whether impacts on sensitive species would occur. Avoidance, minimization, and/or mitigation measures would also be determined at that time. Lease Notice NM-1-LN, which summarizes these responsibilities, is applied to nominated lease parcel 371, which contains potential, suitable, and/or occupied habitat for special status plant species.

The cumulative impact scenario in Section 3.3 provides a quantitative overview of cumulative actions within the analysis area. Past, present, and reasonably foreseeable future actions would result in a total of 427,740 acres of surface disturbance, of which the Proposed Action would comprise approximately 144 acres (0.0003%; see Table 3.1). Qualitatively, vegetation resources would be cumulatively impacted through increased fragmentation of vegetative types, the introduction of invasive species, and the potential for monocultures to develop. Many of the adverse impacts on landscape vegetation density and type resulting from surface disturbances associated with well pads, access roads, and minerals infrastructure would be long term.

AIB-6 Invasive Species (Noxious Weeds)

How would future potential development of the nominated lease parcels impact the introduction and/or spread of noxious weeds and invasive plants?

Surface disturbance, construction equipment, and source materials brought on-site (e.g., caliche, gravel) from future potential development of nominated lease parcels would likely increase the spread and density of invasive plants and noxious weeds. Invasive and noxious weeds invade disturbed sites, spread into adjacent areas, compete with and potentially displace native vegetation, and can contribute to the degradation of soil health by overutilizing soil nutrients. The BLM CFO has observed an increase in noxious weed/invasive plant populations in recent years, and there appears to be a direct correlation between development and associated disturbed areas and the establishment and spread of noxious and/or invasive plants. African rue (*Peganum harmala*), a perennial deep-rooted noxious weed, has proven especially difficult to control because it colonizes every soil type and easily outcompetes native plants for soil nutrients and available water (BLM 2018b). It is estimated that 144 acres would be disturbed as a result of future potential development of the 32 nominated lease parcels. All disturbed acreage would be vulnerable to the establishment and spread of noxious weeds/invasive plants.

Within the BLM CFO, there are ongoing efforts to reduce the presence and spread of these unwanted species by way of prevention and treatment. The most common treatment method is the application of herbicides. In general, the effectiveness of treatments is variable depending on location, species, treatment

type, timing of treatment, and size of population. In the event that noxious weeds are discovered at any time during future potential development, standard lease terms and conditions hold the operator responsible for weed treatment and prevention activities, such as herbicide application and washing vehicles coming from areas with known weed populations. A review of the BLM CFO spatial data of known noxious weed treatment acres concluded that there are known noxious weed occurrences of African rue within parcel 383.

Reclamation is intended to restore previously disturbed sites to a properly functioning natural ecological state. The effectiveness of reclamation efforts varies based upon a number of factors such as soil type, precipitation, herbicide treatments, and additional disturbance. Once physical reclamation of the site has taken place, seeding of native species is intended to reestablish the native plant community and protect the disturbed area from potential establishment of noxious weeds. While reclamation has been shown to increase and restore the health of disturbed sites, the complete eradication of noxious weed species is challenging, and initiation of large-scale control efforts are not feasible at this time (BLM 2018b).

The cumulative impact scenario in Section 3.3 provides a quantitative overview of cumulative actions within the analysis area. The resulting acreage would cumulatively increase the spread of noxious or invasive species. Grazing may potentially spread noxious, invasive, or non-native species through equipment, feed products, and on livestock themselves (BLM 2018b). On a landscape level, the Carlsbad Soil and Water Conservation District has operated a joint county venture (Lea and Eddy Counties) to target certain species for eradication (Carlsbad Soil and Water Conservation District 2019). Together with the standard lease terms and conditions and site-specific approval requirements that require permit holders to treat weeds, there is a countervailing effect that limits the spread of noxious weeds across Eddy and Lea Counties and contributes to controlling the spread on a landscape level. Some of the adverse impacts from development remain, including potential introduction of new species. These remaining impacts would be long term if full eradication of certain introduced species is not achieved. These remaining impacts would likely be long term as full eradication of introduced species is difficult.

AIB-7 Threatened and Endangered Species

How would future potential development of the nominated lease parcels impact threatened and endangered (T&E) species?

According to the USFWS Information for Planning and Consultation system (IPaC) (USFWS 2020a), the threatened and endangered species listed in Table 3.6 have the potential to occur on or in the vicinity of the nominated lease parcels. Desktop analysis of potential for occurrence of these species was also conducted using best available data, including review of aerial mapped vegetation communities (SWReGAP 2020); NHD (USGS 2020a); USFWS NWI data (USFWS 2020b); USFWS descriptions of species habitat requirements; current mapped critical habitat (USFWS 2020a); and BLM Potential Habitat for Special Status Plants (BLM 2020a). In addition to nominated lease parcel specific stipulations and lease notices, stipulation WO-ESA-7 is applied to all parcels providing protections to threatened and endangered species (see Appendices A and C).

Analysis of potential for occurrence of threatened and endangered species at the lease sale stage was conducted in a desktop review format utilizing best available data to assess the potential for habitat to be present within the nominated lease parcels coinciding with known habitat requirements of the aforementioned species. Desktop analysis included review of aerial mapped vegetation communities, NHD (see AIB-2 for further information), USFWS descriptions of species habitat requirements, as well as USFWS mapped critical habitat (SWReGAP 2020; USFWS 2020a, 2020c; USGS 2020a). For all species in Table 3.6 where there is habitat potential, future potential development is not anticipated to create adverse impacts for the following reasons: 1) stipulations and lease notices facilitate the reduction or avoidance of effects, 2) site-specific analysis at the lease development stage provides an additional

opportunity to evaluate effects and develop measures to reduce or avoid effects, and 3) the standard lease terms and conditions that apply to all nominated lease parcels provide the BLM with the authority to require reasonable measures that reduce or avoid effects.

Table 3.6. USFWS IPaC System Threatened and Endangered Species with Potential to Occur on or in the Vicinity of Nominated Lease Parcels

Species (*Scientific Name*) (Status)*	**Potential Habitat**	**Discussion†, ‡**
Birds		
Least tern (*Sterna antillarum*) (E)	Y	No critical habitat has been designated for this species (USFWS 2020a). None of the nominated lease parcels contain riparian habitat (see AIB-5). Freshwater ponds, intermittent lake and/or pond, and perennial lake and/or pond have been identified on seven of the nominated lease parcels (372, 376, 386, 387, 388, 389, and 6741) and riverine wetlands have been identified on three of the nominated lease parcels (394, 6740, and 6741; see AIB-2). Additionally, playas have been identified on seven of the nominated lease parcels (372, 375, 376, 381, 386, 387, and 388) and within 656 feet (200 m) of five of the nominated lease parcels (371, 374, 389, 398, and 6740; see AIB-22), which, along with the surface water features, may provide wetland and shoreline habitat for this species. Stipulation SENM-S-19-CSU‡, is applied to 12 of the nominated lease parcels (371, 372, 374, 375, 376, 381, 386, 387, 388, 389, 398, and 6740), preventing surface disturbance within 200 m of playa features and provides secondary protection to associated potential habitat for this species. Additionally, stipulation SENM-S-18-CSU‡, which provides protections to streams, rivers, and floodplains, would provide protections to surface water features that may provide potential habitat for this species within three of the nominated lease parcels (394, 6740, and 6741). Standard terms and conditions also provide the BLM with the authority to move future potential development to avoid surface water features and playas within any lease.
Mexican spotted owl (*Strix occidentalis lucida*) (T)	N	The nominated lease parcels are outside of critical habitat for this species. Additionally, desktop analysis indicates lack of habitat.
Northern Aplomado falcon (*Falco femoralis septentrionalis*) (EX)	N	No critical habitat has been designated for this species (USFWS 2020a). The Hope Grasslands provides bird of prey habitat, and current management practices have limited the amount of disturbance to the extensive grasslands within the area (BLM 2018c). Desktop analysis indicates lack of habitat for this species as neither Hope Grasslands nor suitable habitat occurs within any of the nominated lease parcels.
Piping plover (*Charadrius melodus*) (T)	Y	The nominated lease parcels are outside of critical habitat for this species (USFWS 2020a). None of the nominated lease parcels contain riparian habitat (see AIB-5). Freshwater ponds, intermittent lakes and/or ponds, and perennial lakes and/or ponds have been identified on seven of the nominated lease parcels (372, 376, 386, 387, 388, 389, 6741), and riverine wetlands have been identified on three of the nominated lease parcels (394, 6740 and 6741) (see AIB-2). Additionally, playas have been identified on seven of the nominated lease parcels (372, 375, 376, 381, 386, 387, and 388) and within 656 feet (200 m) of five of the nominated lease parcels (371, 374, 389, 398, and 6740, see AIB-22) which, along with the surface water features, may provide wetland and shoreline habitat for this species. Stipulation SENM-S-18-CSU‡, which provides protections to streams, rivers, and floodplains would provide protections to surface water features that may provide potential habitat within three of the nominated lease parcels (394, 6740, and 6741) for this species. Stipulation SENM-S-19-CSU‡, is applied to 12 of the nominated lease parcels (371, 372, 374, 375, 376, 381, 386, 387, 388, 389, 398, and 6740), preventing surface disturbance within 200 m of playa features and provides secondary protection to associated potential habitat for this species. Additionally, standard terms and conditions provide the BLM with the authority to move future potential development to avoid surface water features and playas within any lease.

Species (*Scientific Name*) (Status)*	**Potential Habitat**	**Discussion†, ‡**
Southwestern willow flycatcher (*Empidonax traillii extimus*) (E)	Y	The nominated lease parcels are outside of critical habitat for this species (USFWS 2020a). None of the nominated lease parcels contain riparian habitat (see AIB-5). Freshwater ponds, intermittent lakes and/or ponds, and perennial lakes and/or ponds have been identified on seven of the nominated lease parcels (372, 376, 386, 387, 388, 389, and 6741), and riverine wetlands have been identified on three of the nominated lease parcels (394, 6740 and 6741; see AIB-2). Additionally, playas have been identified on seven of the nominated lease parcels (372, 375, 376, 381, 386, 387, and 388) and within 656 feet (200 m) of five of the nominated lease parcels (371, 374, 389, 398, and 6740; see AIB-22), which, along with the surface water features, may provide wetland and shoreline habitat for this species. Stipulation SENM-S-18-CSU‡, which provides protections to streams, rivers, and floodplains would provide protections to surface water features that may provide potential habitat within three of the nominated lease parcels (394, 6740, and 6741) for this species. Stipulation SENM-S-19-CSU‡, is applied to 12 of the nominated lease parcels (371, 372, 374, 375, 376, 381, 386, 387, 388, 389, 398, and 6740), preventing surface disturbance within 200 m of playa features and provides secondary protection to associated potential habitat for this species. Additionally, standard terms and conditions provide the BLM with the authority to move future potential development to avoid surface water features and playas within any lease.
Fish		
Pecos bluntnose shiner (*Notropis simus pecosensis*) (T)	N	The nominated lease parcels are outside of critical habitat for this species (USFWS 2020a). Freshwater ponds, intermittent lakes and/or ponds, and perennial lakes and/or ponds have been identified on seven of the nominated lease parcels (372, 376, 386, 387, 388, 389, and 6741). However, desktop analysis indicates these surface water features are not tributaries or connecting drainages to the Pecos River corridor where this species is known to occur within the CFO planning area (NMDGF 2020).
Pecos gambusia (*Gambusia nobilis*) (E)	N	No critical habitat has been designated for this species (USFWS 2020a). The nominated lease parcels are outside of critical habitat for this species (USFWS 2020a). Freshwater ponds, intermittent lakes and/or ponds, and perennial lakes and/or ponds have been identified on seven of the nominated lease parcels (372, 376, 386, 387, 388, 389, and 6741). However, desktop analysis indicates these surface water features are not tributaries or connecting drainages to the Pecos River or its tributaries where this species is known to occur within the CFO planning area (NMDGF 2020). Parcel 6741 is approximately 53.90 miles southeast of Bitter Lake National Wildlife Refuge, and is 51.20 miles northeast of Blue Spring, which are the nearest known locations of populations of this species within Chaves and Eddy Counties (NMDGF 2020).
Invertebrates		
Texas hornshell (*Popenaias popeii*) (E)	N	No critical habitat has been designated for this species (USFWS 2020a). The nominated lease parcels are outside of the Candidate Conservation Agreement (CCA) and the Candidate Conservation Agreements with Assurances (CCAA) areas for the Texas hornshell mussel and other covered species (USFWS 2020c; USFWS et al. 2017). The closest parcel (parcel 6740) is approximately 27.78 miles north of the CCAA Zone D Boundary. Desktop analysis has identified no known mapped drainages with potential connectivity to Texas hornshell habitat (BLM 2020a; USFWS 2020b, 2020c; USFWS et al. 2017; USGS 2020a).
Plants		
Guadalupe Mountains and Foothills unsurveyed special status plant species	N	This data layer represents the area where additional analysis for species occurrence and suitable habitat needs to be conducted for the following species: Sacramento Mountains thistle (*Cirsium vinaceum* [T]), Sacramento prickly poppy (*Argemone pleiacantha* ssp. pinnatisecta [E]), and Todsen's pennyroyal (*Hedeoma todsenii* [E]). None of the nominated lease parcels are within the BLM-mapped potential habitat for multiple special status plant species expected to and/or known to occur within the Guadalupe Mountain range and foothills.

Species (*Scientific Name*) (Status)*	**Potential Habitat**	**Discussion†, ‡**
Gypsum wild buckwheat (*Eriogonum gypsophilum*) (T)	N	The nominated lease parcels are outside of critical habitat for this species (USFWS 2020a). Desktop analysis of BLM-mapped habitat indicates that none of the nominated lease parcels contain mapped units of gypsiferous "gypsum" soils (Natural Resources Conservation Service 2020), which is the preferred habitat of this species (USFWS 2020a). Additionally, desktop analysis of BLM-mapped habitat indicates that no known occupied or potential habitat is present for this species within any of the nominated lease parcels (BLM 2020a).
Kuenzler's hedgehog cactus (*Echinocereus fendleri* var. *kuenzleri*) (T)	N	No critical habitat has been designated for this species (USFWS 2020a). Desktop analysis of BLM-mapped habitat indicates that no occupied or potential habitat is present for this species within any of the nominated lease parcels.
Lee's pincushion cactus (*Coryphantha sneedii* var. *leei*) (T)	N	No critical habitat has been designated for this species (USFWS 2020a). Desktop analysis of BLM-mapped habitat indicates that no occupied or potential habitat is present for this species within any of the nominated lease parcels.
Sneed's pincushion cactus (*Coryphantha sneedii* var. *sneedii*) (E)	N	No critical habitat has been designated for this species (USFWS 2020a). Desktop analysis indicates that none of the nominated lease parcels contain steep slopes, which is the preferred habitat of this species (New Mexico Rare Plants 2020). In addition, this species is only known to occur in Doña Ana and Eddy Counties, New Mexico and El Paso County, Texas (New Mexico Rare Plants 2020).
Wright's marsh thistle (*Cirsium wrightii*) (C)	Y	No critical habitat has been designated for this species (USFWS 2020a). None of the nominated lease parcels contain riparian and/or marsh habitat (see AIB-5), which is the preferred habitat of this species (USFWS 2020a). Standard terms and conditions provide the BLM with the authority to move future potential development to avoid surface water features within any lease. Additionally, surface water features that may provide potential habitat within three of the nominated lease parcels (394, 6740, and 6741) for this species would be protected by stipulation SENM-S-18-CSU,‡ which provides protections to streams, rivers, and floodplains, and prohibits surface disturbance within up to 200 m of the outer edge of 100-year floodplains (see AIB-2).

* C = Candidate species undergoing USFWS review, E = Endangered, EX = Experimental Population, Non-Essential, T = Threatened

† None of the nominated lease parcels are within species-specific critical habitat.

‡ See Appendix C for summaries of stipulations and lease notices.

The cumulative impact scenario in Section 3.3 provides a quantitative overview of cumulative actions within the analysis area. The resulting cumulative acreage impacts across the landscape would contribute to additional potential for habitat loss, and fragmentation that could affect species listed previously. The BLM is working with other land management agencies to restrict and manage development near habitat for the species listed through the Candidate Conservation Agreement (CCA), species-specific studies, and other requirements ahead of locating well pads and infrastructure.

AIB-8 Sensitive Species

How would future potential development of the nominated lease parcels impact sensitive species?

Sensitive species that have the potential to occur within the nominated lease parcels due to the presence of habitat with species-specific characteristics and/or BLM-mapped potential habitat are described in Table 3.7 (BLM 2018c). No additional sensitive species are known to occur on, or in the vicinity of, the nominated lease parcels, though parcel-specific data are limited. Site selection of the 144 acres of potential surface disturbance associated with the development of the nominated lease parcels would occur after pre-disturbance biological surveys and additional analysis and disclosure of potential impacts on

sensitive species at the time of lease development. For more information regarding general wildlife, including game species and the New Mexico State Wildlife Action Plan, see AIB-15.

Additionally, it was determined that under future potential development of the nominated lease parcels, the DSL and LPC and/or their habitats could be disturbed. Detailed analysis of potential impacts on these two species are analyzed separately in Chapter 3 (Section 3.5.4).

Analysis of potential for occurrence of sensitive species at the lease sale stage was conducted in a desktop review format utilizing best available data to assess the potential for habitat to be present within the nominated lease parcels coinciding with known habitat requirements of the aforementioned species. Desktop analysis included review of aerial mapped vegetation communities, NHD (see AIB-2 for further information), published descriptions of species habitat requirements, as well as USFWS mapped critical habitat (Biota Information System of New Mexico [BISON-M] 2020; SWReGAP 2020; USGS 2020a).

Depending on the proximity of ground disturbance and development activity to sensitive species habitat and/or populations, there could be impacts on sensitive species and the ecological processes that sustain them related to changes in the following habitat conditions: ground cover, soil nutrient flows and processes, hydrological flows and processes, solar exposure, thermal cover, fugitive dust loads, non-native species dispersal, habitat connectivity, noise levels and human activity, light pollution, forage availability, and pollinator and dispersal agents' visitation behaviors. If detected and avoided, actual impacts on special status plant species would be less than estimated as potential in this analysis. It is not certain that detected occupied habitat could be avoided, given valid existing lease rights and other resource conflicts in the vicinity of proposed development locations. Impacts may also be lower than estimated as potential in this analysis when single pads host multiple wells.

For all species in Table 3.7 where there is potential for occurrence, future potential development is not anticipated to create adverse impacts as standard terms and conditions would apply to all parcels including a requirement of pre-disturbance surveys at the time of proposed lease development. The surveys would identify occurrences of special status plant species and special status wildlife habitat for avoidance during project siting and construction. The BLM would conduct site-specific evaluations at the lease development stage for any future actions within the lease parcels to determine whether impacts on sensitive species would occur. Avoidance, minimization, and/or mitigation measures would also be determined at that time. Lease Notice NM-1-LN, which summarizes these responsibilities for special status plant species, is applied to nominated lease parcel 371, which contains BLM-mapped potential habitat for Scheer's beehive cactus (*Coryphantha robustispina* ssp. *scheeri*) (BLM 2020a). Stipulation SENM-S-17 (under which occupancy or use of fragile soils is considered on a case-by-case basis) is also applied to all or portions of nominated lease parcels 361, 366, 369, 382, 390, and 6741 (see Appendix A). Additionally, stipulation SENM-S-54-NSO is applied entirely to nominated lease parcel 370 and to portions of nominated lease parcel 6741 (see Appendices A and C) for LPC habitat, which may also provide concomitant protection to other species which utilize this habitat.

Table 3.7. Known Sensitive Species Habitat within Nominated Lease Parcels

Species (*Scientific Name*)	Potential Habitat	Parcel Number (acreage)	Potential for Occurrence
Birds			
Baird's sparrow (*Ammodramus bairdii*)	Y	368 (40), 391 (80), 393 (154.57), 394 (718.3), 6741 (320)	This species is a winter resident in New Mexico. It generally prefers dense, extensive grasslands with few shrubs, and avoids heavily grazed areas. The nominated lease parcels contain grassland habitat, which may indicate potential habitat for this species (see AIB-5).
Chestnut-collared longspur (*Calcarius ornatus*)	N	368 (40), 391 (80), 393 (154.57), 394 (718.3), 6741 (320).	This species migrates and winters in the East, and migrates westward locally to the vicinity of the Rio Grande valley, and occasionally farther in the Southwest. This species is considered uncommon to abundant and is most numerous in the southernmost area of the Rio Grande valley and is regular in the Mogollon Plateau (Hubbard 1978). Chestnut-collared longspurs were often seen within, or in association with, open grassland habitats. The sites that were used most often were dominated by desert saltgrass (*Distichlis spicata*), with occasional clumps of fourwing saltbush (*Atriplex canescens*) interspersed. Adjacent sites having an even greater shrub component were also occasionally used (Baltosser 1991). Although the nominated lease parcels contain grassland habitat, these vegetation types do not contain open plains grassland inhabited by this species; therefore potential habitat for this species is unlikely to occur (see AIB-5).
McCown's longspur (*Calcarius mccownii*)	Y	384 (240), 391 (80), 393 (154.57), 394 (718.3), 398 (160)	This species is found in Sonoran desertscrub, Chihuahuan desertscrub, annual grassland, farms, and mountain and alpine meadows. It is associated with open to dense vegetation of shrubs, low trees, and succulents, dominated by paloverde (*Cercidium microphyllum*), pricklypear (*Opuntia* sp.), and giant saguaro (*Cereus giganteus*) (U.S. Department of Agriculture 1991). The nominated lease parcels contain Chihuahuan desertscrub habitat, which may indicate potential habitat for this species (see AIB-5).
Sprague's pipit (*Anthus spragueii*)	Y	368 (40), 391 (80), 393 (154.57), 394 (718.3), 6741 (320)	This species occurs in New Mexico only as a sporadic winter resident. It is associated with southern desert grasslands of the state. The species as a whole prefers dry, open grasslands. The nominated lease parcels contain grassland habitat, which may indicate potential habitat for this species (see AIB-5).
Western burrowing owl (*Athene cunicularia hypugaea*)	Y	368 (40), 391 (80), 393 (154.57), 394 (718.3), 398 (160), 6741 (320)	This species is found in grasslands, especially in association with prairie dog colonies, in desertscrub, and in agricultural and semi-urban environments. The nominated lease parcels contain grassland and desertscrub habitat, and potential prairie dog habitat, which may indicate potential habitat for this species (see AIB-5).
Mammals			
Black-tailed prairie dog (*Cynomys ludovicianus arizonensis*)	Y	361 (80), 368 (40), 369 (40), 371 (80), 372 (576.51), 374 (80), 375 (80), 376 (960), 378 (320), 379 (320), 380 (40), 381 (160), 382 (42.3), 383 (80), 386 (160), 387 (160), 388 (80), 389 (320), 390 (40), 391 (80), 392 (50.68), 393 (154.57), 394 (718.3), 6741 (320), 6742 (80)	This species prefers grasslands, including short- and mixed-grass prairie, sagebrush steppe, and desert grasslands. It is also known to occur in mesquite–creosote bush, grama–needlegrass, tarbush–creosote bush, and burrograss–cholla type habitats. The nominated lease parcels contain grassland and prairie habitat, which may indicate potential habitat for this species (see AIB-5).

Species (*Scientific Name*)	**Potential Habitat**	**Parcel Number (acreage)**	**Potential for Occurrence**
Long-legged myotis bat (*Myotis volans interior*)	Y	368 (40), 384 (240), 391 (80), 393 (154.57), 394 (718.3), 398 (160), 6741 (320)	Primarily a forest species occurring in chaparral, alpine and subalpine grassland, coniferous forest, scrub-grassland, Chihuahuan desertscrub, swamp and riparian forests and scrub, saxicoline brush, oak savanna, and woodland, Mohave desertscrub, and upland Sonoran desertscrub. The nominated lease parcels contain grassland and desertscrub habitat (see AIB-5), which may indicate potential habitat for this species.
Spotted bat (*Euderma maculatum*)	Y	372 (576.51), 376 (960), 386 (160), 387 (160), 388 (80), 389 (320), 394 (18.3), 6740 (40), 6741 (320)	In New Mexico, spotted bats have been known to inhabit areas near cliffs, including piñon-juniper woodlands and from streams or water holes within ponderosa pine or mixed coniferous forest. They have also taken over cattle tanks in a meadow surrounded by mixed coniferous forest and near a ridge with cliffs and limestone outcroppings. Spotted bats are usually observed around water sources, including desert pools or cattle tanks. They also may use rivers or desert washes as travel corridors. The nominated lease parcels contain surface water features, which may indicate potential habitat for this species (see AIB-2).
Townsend's pale big-eared bat (*Corynorhinus townsendii pallescens*)	Y	361 (80), 363 (120), 366 (80), 368 (40), 369 (40), 370 (160), 371 (80), 382 (42.3), 383 (80), 384 (240), 386 (160), 387 (160), 388 (80), 389 (320), 390 (40), 391 (80), 393 (154.57), 394 (718.3), 398 (160), 6738 (80), 6740 (40), 6741 (320), 6742 (80)	Found in a variety of xeric to mesic habitats: scrub-grassland, desertscrub, semi-desert shrublands, chaparral, saxicoline brush, tundra, open montane forests, spruce-fir, mixed hardwood-conifer, and oak woodlands and forests. This species is strongly correlated with the availability of caves or cave-like habitat, but it also uses abandoned buildings and rock crevices on cliffs for roosting. The nominated lease parcels contain scrub-grassland, desertscrub, semi-desert shrublands habitat (see AIB-15), which may indicate potential habitat for this species.
Reptiles and Amphibians			
Desert massasauga (*Sistrurus tergeminus*)	Y	361 (80), 368 (40), 369 (40), 371 (80), 372 (576.51), 374 (80), 375 (80), 376 (960), 378 (320), 379 (320), 380 (40), 381 (160), 382 (42.3), 383 (80), 386 (160), 387 (160), 388 (80), 389 (320), 390 (40), 391 (80), 392 (50.68), 393 (154.57), 394 (718.3), 6741 (320), 6742 (80)	This species primarily inhabits desert grasslands or shortgrass prairies with sandy soil in valleys, on low sloping alluvial fans, and on rolling grass-covered hills within semidesert grassland habitats. The nominated lease parcels contain grassland and prairie habitat, which may indicate potential habitat for this species (see AIB-5).
Plants			
Scheer's beehive cactus (*Coryphantha robustispina* ssp. *scheeri*)	Y	371 (80)	BLM-mapped potential habitat occurs in parcel 371 (20.06 acres, 25.04% of total parcel acreage) (BLM 2020a). Future potential development within the nominated lease parcels could reasonably be expected to directly impact up to 4.5 acres, or 0.00001% of the species mapped potential habitat (462,191.94 acres).

Species (*Scientific Name*)	**Potential Habitat**	**Parcel Number (acreage)**	**Potential for Occurrence**
Wind Mountain rock-cress (*Boechera zephyra*)	Unknown	384 (240), 391 (80), 393 (154.57), 394 (718.3), 398 (160)	This species has potential to occur within the BLM CFO, specifically Eddy County, New Mexico (BLM 2018c; New Mexico Rare Plant Technical Council (1999, updated September 2020), and is also within the "Guadalupe Mountains and Foothills" suite of species. This species can be found on rocky syenite, limestone, or basaltic scoria slopes, and primarily occurs in the upper margins of Chihuahuan desertscrub and occasionally occurs in juniper savanna or oak-juniper woodlands. The nominated lease parcels contain desertscrub habitat, which may indicate potential habitat for this species (see AIB-5).

With consideration of these stipulations and standard terms and conditions, future potential development of the nominated lease parcel can reasonably be expected to not impact the viability of the species listed in Table 3.7. If detected and avoided, actual disturbance to special status plant species would be less than estimated in Table 3.7. The cumulative impact scenario in Section 3.3 provides a quantitative overview of cumulative actions within the analysis area. The resulting acreage impacts across the landscape would cumulatively contribute to additional potential for habitat loss, and fragmentation that could affect sensitive species. The BLM is working with other land management agencies to restrict and manage development through establishment of management protocols to identify and map potential and occupied habitat areas, requiring species-specific inventories and studies, and other requirements ahead of locating well pads and infrastructure. Methods to minimize impacts on individuals and habitats would be applied into the future for RFFAs as well, and the resulting cumulative impacts from landscape-wide development would be minimized or restricted from protected habitat areas. The remaining cumulative impacts from landscape-level development lead to long-term habitat loss and fragmentation.

AIB-9 Migratory Birds

How would future potential development of the nominated lease parcels impact migratory birds?

The nominated lease parcels fall within the North American Bird Conservation Initiative Bird Conservation Region (BCR) 18 (Shortgrass Prairie) and BCR 35 (Chihuahuan Desert) (Partners in Flight 2020a; USFWS 2020a). The New Mexico Avian Conservation Partners developed two conservation lists (Level 1 and Level 2) based on distribution, threats, global population size, New Mexico population trend, and importance of New Mexico to breeding or wintering (Partners in Flight 2020a, 2020b). The two lists contain species that are of the highest conservation concern in New Mexico. Some of the continent's highest-priority birds of conservation concern breed in BCR 18 and include the mountain plover (*Charadrius montanus*), long-billed curlew (*Numenius americanu*s), ferruginous hawk (*Buteo regalis*), and LPC (New Mexico Avian Conservation Partners 2016). Playa lakes habitat consists of numerous shallow wetlands that support many wintering ducks, migrant shorebirds, and some breeding species, such as snowy plover (*Charadrius nivosus*) (New Mexico Avian Conservation Partners 2016). Species of highest conservation concern found in BCR 35, which require desertscrub and grassland habitats, include aplomado falcon (*Falco femoralis*), prairie falcon (*Falco mexicanus*), scaled quail (*Callipepla squamata*), Bendire's thrasher (*Toxostoma bendirei*), wintering Sprague's pipit (*Anthus spragueii*), and wintering McCown's longspur (*Rhynchophanes mccownii*) (New Mexico Avian Conservation Partners 2016). In montane areas of BCR 35, species of highest concern include Mexican spotted owl (*Strix occidentalis lucida*) (New Mexico Avian Conservation Partners 2016). In riparian areas, species of highest concern include southwestern willow flycatcher (*Empidonax traillii extimus*), Bell's vireo (*Vireo bellii*), and Lucy's warbler (*Oreothlypis luciae*) (New Mexico Avian Conservation Partners 2016). For more information regarding general wildlife, including game species, and the New Mexico State Wildlife Action Plan, see AIB-15.

Habitat fragmentation, alteration, and/or loss have changed how birds move through landscapes and use the remaining habitat. Loss, alteration, and fragmentation of habitat are among the main reasons why biodiversity is decreasing in many places worldwide. The primary drivers of habitat loss and fragmentation within this area are oil and gas development, livestock grazing, and mining. However, habitat loss, alteration, or fragmentation that occurs within the CFO may not be the contributing factor causing population declines in respective migratory bird populations. Taylor and Stutchbury (2015) state "that habitat loss in one region can effect sub-populations in regions that are not directly connected." Habitat loss on wintering grounds south of the United States border, and local drought conditions can contribute to population declines in migratory birds that occur within the CFO. This regional habitat continues to provide for the life cycles of these birds notwithstanding known drivers of habitat loss as described above.

Under the Proposed Action, the BLM would lease 32 parcels, and future potential development of the nominated lease parcels would result in approximately 144 acres of disturbance. Most impacts would occur at the initial stages of lease development. These disturbances include construction and drilling, human presence, traffic, heavy equipment, and noise associated with lease development activities. Bird species not tolerant of these activities may leave and avoid the area altogether for the duration of construction or move into nearby undisturbed habitat patches.

Compliance with the Migratory Bird Treaty Act would be required for any future potential developments and would follow the BLM CFO Migratory Bird Policy, which could include timing limitation constraints on developments within the nominated lease parcel during migration and nesting seasons. The BLM's authority under standard terms and conditions would result in the application of measures to mitigate effects on migratory birds at the lease development level. Developmental constraints during spring and fall migrations and nesting seasons, as well as nest surveys, may be required prior to implementation of lease development activities. Some of these include the application of netting over open tanks, raptor-safe power line construction standards, and sound mufflers. In addition, avoidance of active avian nests and burrows or delays of development activities may be required.

The cumulative impact scenario in Section 3.3 provides a quantitative overview of cumulative actions within the analysis area. The resulting acreage impacts across the landscape would cumulatively contribute to additional potential for migratory bird habitat loss and fragmentation. Habitat loss impacts would be long term, and, in some cases, reclamation would not fully rehabilitate migratory bird habitat to pre-development conditions.

AIB-10 Paleontological Resources

How would future potential development of the nominated lease parcels impact paleontological resources?

The Potential Fossil Yield Classification (PFYC) is a tool that allows the BLM to predict the likelihood of a geologic unit to contain paleontological resources. The PFYC is based on a numeric system of 1–5. An area identified as PFYC 1 has very low likelihood of containing paleontological resources, whereas an area identified as PFYC 5 is a geologic unit that has a very high likelihood to contain scientifically significant paleontological resources. Within areas identified as PFYC 2 or 3, paleontological resource management concern is generally low to moderate because the likelihood of encountering scientifically significant fossils is relatively low to moderate. Within areas identified as PFYC 4, paleontological resource management concerns are moderate to high, as the probability of impacting scientifically significant paleontological resources is generally moderate to high. The PFYC classes of the 32 nominated lease parcels are provided in Table 3.8.

Utilizing currently available geological mapping at 1:500,000 scale, 17 nominated lease parcels are in areas mapped as geologic units with PFYC 2 designations and 15 nominated lease parcels are in areas mapped as geologic units with PFYC 3 designation. However, spread throughout the tri-county analysis area are smaller outcrops of late-Pleistocene deposits associated with ancient lakes that have produced scientifically important paleontological resources, such as the Hackberry Lake fossil area and Jal fossil area to the southeast (Morgan and Harris 2015). At this scale, many of these smaller outcrops that do contain scientifically important fossils are not represented in the map data. With refined geologic mapping these smaller outcrops, which are often partially covered by younger eolian dunes, would be assigned a PFYC 4 or U (unknown).

There are no known paleontological localities within any of the nominated lease parcels listed in Table 3.8. However, one lease parcel (371) is within 3.25 miles of the important Hackberry Lake fossil area (Morgan and Harris 2015). Nine nominated lease parcels (361, 363, 366, 382, 383, 384, 390, 6740,

and 6741) mapped as PFYC Class 2 Quaternary eolian and pediment deposits could contain deposits similar to those containing fossils at Hackberry Lake or Jal. Stipulation SENM-S-54-NSO is applied entirely to nominated lease parcel 370 and to portions of nominated lease parcel 6741 (see Appendices A and C) for LPC habitat, that may provide protection to paleontological resources.

Table 3.8. Geologic Unit and PFYC Class of the Nominated Lease Parcels

Geologic Unit	PFYC Class	Parcel(s) (acres)	Total Acres of Geologic Unit within Parcels (acres)	Estimated Acres of Surface Disturbance
Quaternary eolian deposits	Class 2	15% of 6740 (6.16)	6.16	0.69
Quaternary Eolian and Piedmont deposits	Class 2; may contain localized unmapped areas of PFYC Class 4 or U (unknown)	100% of 361 (80.06), 363 (119.90), 366 (80.07), 368 (40.07), 369 (40.01), 370 (160.10), 382 (42.31), 383 (80.26), 384 (239.64), 390 (40.11), 6738 (79.87), 6741 (320.13), 30% of 394 (215.46), and 85% of 6740 (33.76)	1,571.74	59.18
Quaternary Piedmont deposits	Class 2; may contain localized unmapped areas of PFYC Class 4 or U (unknown)	100% of 371 (80.02), 391 (80.63), 393 (155.62), and 70% of 394 (507.86)	824.13	16.65
Tertiary Ogallala Formation	Class 3	100% of 372 (576.93), 374 (80.16), 375 (80.18), 376 (960.58), 378 (320.31), 379 (319.63), 380 (39.98), 381 (160.09), 386 (159.87), 387 (159.6), 388 (79.94), 389 (319.30), 392 (51.04), 398 (160.35), 6742 (80.09)	3,548.06	67.5

Direct impacts would result in the immediate physical loss of fossils and their contextual data. Impacts indirectly associated with ground disturbance could subject fossils to damage or destruction from erosion and create improved access to the public and increased visibility, potentially resulting in unauthorized collection or vandalism. Ground disturbance can also reveal scientifically significant fossils that would otherwise remain buried and unavailable for scientific study. Such fossils can be collected properly and curated into the museum collection of a qualified repository, making them available for scientific study and education.

Impacts on paleontological resources can be mitigated by standard terms and conditions, which require a lessee to conduct inventories or special studies at the discretion of the BLM. If in the conduct of operations paleontological resources are discovered, the lessee must cease any operations that would result in the destruction of such specimens and contact the BLM Authorized Officer. Paleontological surveys may be required at the lease development level in areas where there is a higher probability to impact paleontological resources before work is authorized. Additional mitigation measures may be applied based on the results of the survey and would be applied as COAs.

Future potential development would be analyzed further through separate NEPA processes, as directed by regulations and current policy. Site-specific projects that would cause surface disturbance in areas with unknown or moderate to high potential may be required to have a paleontological survey and/or monitoring conducted at time of proposed lease development in accordance with NEPA, Paleontological Resources Preservation Act (PRPA), and FLPMA. In this scenario, any impacts on paleontological resources of scientific interest would be reduced or avoided. Scientifically significant paleontological

resources discovered through surveys or monitoring would be collected by a permitted paleontologist and curated at an appropriate repository. If previously identified, paleontological localities located in or near APD sites would be avoided. If, in the conduct of operations, paleontological resources are uncovered as inadvertent discoveries, the lessee must cease any operations that would result in the destruction of the resource and contact the lessor (BLM).

The cumulative impact scenario described in Section 3.3 provides a quantitative overview of cumulative actions within the analysis area. The risk of impacts on paleontological resources from the RFFAs outlined in Table 3.1 would depend on the locations of proposed disturbance relative to PFYC class. As currently mapped, almost all of the analysis area is PFYC 2 and 3, and there are no PFYC 5 areas identified in the area (BLM 2019c). As such, the cumulative risk would be low to moderate, and the same measures for minimizing impacts at the site-specific level as described above would be followed for RFFAs.

AIB-11 Fluid Minerals

How would future potential development of the nominated lease parcels impact fluid minerals and energy production?

Depending on the success of oil and gas well drilling, non-renewable natural gas and/or oil would be extracted and delivered to market. Current annual production within the analysis area is estimated to be 278,000,000 bbl of oil and 425.6 billion cubic feet of gas. In addition, 1,933,183 acres of the analysis area is leased. The total future estimated production from the 32 nominated lease parcels is 5,376,000 barrels of oil and 31,347,200 thousand cubic feet (mcf) of gas (see Table 2.1). Future potential development of the 32 nominated lease parcels would include 144 acres of surface disturbance and would add 5,942.36 acres to the total amount of the analysis area that is leased (0.003% more). The nominated lease parcels would contribute an additional 0.02% oil and 0.007% gas production within the analysis area. Oil and gas development is consistent with various laws, including FLPMA (43 United States Code [USC] Section 1701 et seq.), that mandate that the BLM administer for the exploration and development of these mineral resources on public lands for the benefit of the citizens of the United States. Additionally, there are currently 10 parcels (361, 363, 369, 370, 378, 381, 392, 394, 6738, and 6740) containing one reclaimed oil or gas well; three parcels (366, 372, and 383) containing two reclaimed oil and/or gas wells; and one parcel (384) containing nine reclaimed oil and/or gas wells. While site selection for future potential development within these nominated lease parcels may be limited due to various resource constraints, BLM has confirmed that the nominated lease parcels are suitable for future potential development (BLM 2020b).

The cumulative impact scenario described in Section 3.3 would result in potential for development of an RFD scenario of 16,000 wells in addition to other mineral development. Development of all 16,000 wells would produce 1,817,700,000 bbl of oil and 6,981,800,000 mcf of gas over 20 years. As with the Proposed Action, development of the RFD scenario is consistent with laws mandating development of mineral resources on public lands. The Proposed Action would comprise 0.002% of all reasonably foreseeable future oil and gas development.

AIB-12 Potash, Solid, and Leasable Minerals

How would future potential development of the nominated lease parcels impact solid and other leasable minerals, such as potash?

Potash resources in southeast New Mexico are located in an area governed by the rules of the Secretary of the Interior's 2012 Order dated December 4, 2012. This area is commonly called the Secretary's Potash Area (SOPA). The Secretary's 2012 Order was written to establish rules for concurrent operations in

prospecting for, development of, and production of oil and gas and potash deposits owned by the United States within the designated Potash Area. The SOPA completely encompasses the Known Potash Leasing Area, which was established for the administration of potassium leasing. The SOPA is composed of four classifications respective to the density of core holes or geophysical inference: Measured Ore (Potash Enclave), Indicated Ore, Inferred Ore, and Barren of Potash Ore. Oil and gas development within Measured Ore (Potash Enclave) reserves would affect economical potash resources. Development in areas that are Indicated or Inferred Ore may affect economical potash reserves or resources. Oil and gas development in areas that are barren of potash reserves would not affect economical potash reserves or resources.

Approximately 240 acres (100%) of nominated lease parcel 384 (240 acres) is located within the SOPA and contains approximately 207.63 acres (86.64 %) of inferred potash probability. Stipulation SENM-S-1-CSU and lease notice SENM-LN-6 are applied to parcel 384 (see Appendix C). Additionally, a lease notation has been applied to nominated lease parcel 384 for Section 22 E2SE, SWSE and Section 23 SWNW, W2SW Township 22S, Range 29E (240 acres) (see Appendix C for lease notation details). None of the remaining nominated lease parcels are within the SOPA and are determined to not have an impact on potash minerals. The next closest, parcel 363, is located approximately 1 mile west of the SOPA. No solid or leasable mineral resources were identified within the nominated lease parcels. Parcel 391 is approximately 0.22 mile west of the Lea County open-pit mine (aggregate and caliche), and parcel 383 is approximately 0.66 mile east of the Caprock Sand and Gravel open-pit mine (aggregate and caliche).

With consideration of the lease notations and stipulations applied to parcel 384, future potential development of the nominated lease parcel is not expected to interfere with operations of the potash drill island and the active potash mine working, and these facilities would remain open for use. This would ensure an adequate supply of mineral materials remains and is available to support development in the area without needing to open new pits.

The cumulative impact scenario described in Section 3.3 would result in potential for development of 16,000 wells (the RFD) in addition to other mineral development. It is assumed that some portion of this development of the RFD could occur in the SOPA. Impacts would vary depending on the area of the SOPA in which the reasonably foreseeable future wells would be developed. Potential impacts would be examined at the site-specific development stage.

AIB-13 Livestock Grazing

How would future potential development of the nominated lease parcels impact livestock grazing?

There are 10 grazing allotments that are intersected by the nominated lease parcels (Table 3.9). Of the 32 nominated lease parcels, parcels 370, 376, 379, 386, 387, and 392 contain or are within 656 feet (200 m) of one or more livestock watering wells (see AIB-1 for more information), and parcel 6741 is within 200 m of one livestock water trough.

Table 3.9. Grazing Allotments by Parcel

Grazing Allotment(s)	Parcel Number(s) (total parcel acreage, and parcel acreage and percent of parcel acreage within allotment)	Estimated Acres of Surface Disturbance	Percent of Grazing Allotment
Burton North No. 77009 30,018.81 acres	6740 (40 acres, 39.91 acres, 99.75%)	4.5	0.0001%
Cedar Lake No. 77008 17,922.90 acres	366 (80 acres, 80 acres, 100%)	4.5	0.0003%
Eddy 13 No. 76058 7,381.32	6741 (320 acres, 320 acres, 100%)	4.5	0.0006%
Greenwood Lake No. 77112 22,126.89	371 (80 acres, 80 acres, 100%)	4.5	0.0002%
Hart Ranch No. 76049 14,237.68	361 (80 acres, 80 acres, 100%)	4.5	0.0003%
Laguna Tanto No. 76011 101,336.46	384 (240 acres, 239.64 acres, 99.85%) 390 (40 acres, 40 acres, 100%)	9	0.00009%
Maljamar II No. 76107 15,933.19	381 (160 acres, 2.10 acres, 0.01%)	4.5	0.0002%
Maljamar South No. 76007 18,226.71	368 (40 acres, 40 acres, 100%) 369 (40 acres, 40 acres, 100%) 370 (160 acres, 160 acres, 100%) 382 (42.3 acres, 42.3 acres, 100%) 383 (80 acres, 80 acres, 100%)	22.5	0.001%
Sand Hill No. 77007 6,868.15	363 (120 acres, 119.9 acres, 99.91%)	4.5	0.0007%
South Turkey Track No. 77075 140,207.93	363 (120 acres, 0.1 acres, 0.09%) 6738 (80 acres, 79.87 acres, 99.84%)	9	0.00006%

Note: The analysis contained in this EA generally provides percentage contribution rounded to two decimal points. As such, percentages may not always sum to 100 due to rounding.

Future potential development would involve vegetation removal and changes to forage conditions. Alterations to existing range improvements are also possible. Surface disturbance for future potential development of the nominated lease parcels would affect between 0.00006% and 0.001% of the allotments. Stipulation SENM-S-54-NSO is applied entirely to nominated please parcel 370 and to portions of nominated lease parcel 6741 (see Appendices A and C) for LPC habitat, which may provide protection to livestock, grazing allotments, and range improvements. However, due to the size of present grazing allotments, off-lease development may lead to equitable surface disturbance within the grazing allotments or adjacent allotments.

The BLM's authority under standard lease terms and conditions would allow for the application of measures to mitigate livestock grazing–related impacts. The cumulative impact scenario described in Section 3.3 provides a quantitative overview of cumulative actions within the analysis area. Additionally,

the cumulative impact scenario described in Section 3.3 would result in a cumulative loss of forage across the allotments within the analysis area. Proposed vegetation treatments and reclamation projects would ultimately contribute to cumulatively long-term countervailing impacts as new forage for livestock grazing is made available through revegetation.

AIB-14 Recreation

How would future potential development of the nominated lease parcels impact dispersed public recreation?

Oil and gas–related disturbances have the potential to modify recreation opportunities and the recreation experience primarily as a result of changes in the landscape (viewshed), soundscape (noise), habitat loss, and presence of oil and gas development–related activities (construction, traffic, etc.).

There are no Special Recreation Management Areas (SRMA)[5] within any of the nominated lease parcels, however, all leases are within an Extensive Recreation Management Area (ERMA).[6] Management of ERMAs is commensurate with the management of other resources and resource uses. Future potential development of the nominated lease parcels would result in approximately 144 acres of surface disturbance within the ERMA (less than 0.002% of the 4.5 million acres of public lands in the Pecos District available for dispersed recreation). Oil and gas development–related equipment and structures would be present in the areas of development. This disturbance is unlikely to change overall dispersed recreation opportunities or the experience of dispersed recreation within the ERMA because of the limited scale of the proposed development and the presence of substantial existing oil and gas development (see Table 3.1). There may be some small increases in access for dispersed recreation due to new roads. Nominated lease parcel 371 is approximately 0.26 mile east of the Hackberry Lake Off-Highway Vehicle (OHV) Use Area; future potential development of this nominated lease parcel is not expected to impact access or recreation opportunities to this area.

The nearest nominated lease parcel (6740) is 38.8 miles northeast of the boundary of CCNP, and 61.46 miles northeast of the boundary of GUMO. As such, future potential development of the nominated lease parcels is not expected to impact access, dispersed recreation, or noise for CCNP or GUMO beyond existing conditions. See AIB-16, AIB-17, and AIB-24 for more information regarding visual impacts and socioeconomic impacts to CCNP and recreation.

Information on Game Management Units (GMUs) managed by the NMDGF are discussed in AIB-15. The nominated lease parcels would comprise 5,942.36 acres of GMU 31 (5,340,536.21 acres). Future potential development of the nominated lease parcels is anticipated to impact approximately 144 acres (0.00003%) of GMU 31. Impacts on hunting opportunities are not anticipated given the amount of GMUs present within the nominated lease parcels.

The cumulative impact scenario described in Section 3.3 provides a quantitative overview of cumulative actions within the analysis area. Past, present, and reasonably foreseeable future actions would result in a total of 427,740 acres of surface disturbance, of which the Proposed Action would comprise approximately 0.0003% (see Table 3.1). In consideration of past, present, and reasonably foreseeable future actions, cumulative noise disturbances from oil and gas development could impact recreational activities, specifically regarding CCNP. However, due to past and present development and nominated

[5] The BLM's land use plans may designate SRMAs to provide specific for recreational opportunities, such as developing trailhead areas for hikers, mountain bikers, or off-road vehicle users (BLM 2020c).

[6] An ERMA is an area where recreation is unstructured, dispersed, and where minimal recreation-related investments are required. All BLM lands not designated as a Special Recreation Management Area (SRMA) are considered an ERMA in the 1997 Carlsbad Approved RMP, as amended (BLM 1997a). This does not apply to private or state lands.

lease parcel proximity to CCNP, future potential development of the nominated lease parcels is not expected to result in impacts to recreation activities (including existing soundscape) at CCNP.

AIB-15 General Wildlife and Game Species

How would future potential development of the nominated lease parcels impact wildlife, including game and non-game species?

The analysis area contains populations of big-game species, including mule deer (*Odocoileus hemionus*) and pronghorn (*Antilocapra americana*), as well as a multitude of other non-game species. Carnivores include bobcat (*Lynx rufus*), coyote (*Canis latrans*), badger (*Meles meles*), swift fox (*Vulpes velox*), and striped skunk (*Mephitis mephitis*). Two upland game bird species, mourning dove (*Zenaida macroura*) and scaled quail, are prevalent throughout the area as well. Disturbance from future potential development of the nominated lease parcels can result in direct loss of vegetation, burrows, and nests, and could also cause habitat loss and fragmentation and mortalities. Future potential development may also have indirect impacts on pronghorn and mule deer, such as in avoidance of areas within and near the nominated lease parcels.

Future potential development of the nominated lease parcels would result in approximately 144 acres of surface disturbance within the nominated lease parcels (less than 0.00001% of the acreage in the approximately 9.3 million-acre analysis area). Pre-disturbance surveys would be required at the time of proposed lease development in accordance with standard terms and conditions of the lease. The surveys would analyze potential impacts on game and non-game species habitat. Avoidance, minimization, and/or mitigation measures would also be determined at that time. The BLM has the authority under standard terms and conditions to attach COAs at the site-specific level to minimize adverse impacts on resource values at the time operations are proposed. Examples of potential mitigation measures include: design modifications to avoid or minimize impacts to sensitive habitats; limiting the number of well pads under simultaneous construction; seasonal restrictions; limiting the number of proposed roads, reclaiming old and/or unnecessary roads; minimizing truck traffic; noise-buffering measures; pre-development surveys; or use of special construction techniques to minimize surface disturbance to sensitive areas.

Game Management Units (GMUs) are subdivisions used to manage big game species in the state. These GMUs are designated and mapped by the NMDGF and are readily available through its annual hunting proclamation and website (http://www.wildlife.state.nm.us/hunting/maps/big-game-unit-maps-pdfs/). The NMDGF has provided a set of guidelines that are useful to guide oil and gas development statewide. Specifically, these guidelines can be applied in areas where potential conflicts occur between development and the various wildlife species present (NMDGF 2007). All of the nominated lease parcels (5,942.36 acres) are within GMU 31 (5,340,536.21 acres). Future potential development of the nominated lease parcels is anticipated to impact approximately 144 acres (0.00003%) of GMU 31.

The BLM CFO planning area contains year-round habitat for big-game species including mule deer and pronghorn. Currently, there are no mapped migration corridors within the BLM CFO planning area (NMDGF 2019). In accordance with Secretarial Order (SO) 3362, the NMDGF has identified priority areas for further research within their New Mexico State Action Plan (NMDGF 2019), and these priority areas were based on big game units. The NMDGF is currently conducting research on movement routes and/or defined wintering areas for mule deer and pronghorn. In coordination with NMDGF, the BLM CFO is completing fence modification and grassland restoration efforts for pronghorn. Regarding development, both mule deer and pronghorn have been observed moving out of an area during construction phases of oil and gas development; however, individuals move back into an area once projects reach general operation phases with decreased disturbance (Sherman 2019). The only mapped migration corridor in New Mexico is within the Farmington Field Office (reflected in the NMDGF New Mexico State Action Plan [NMDGF 2019]), which is outside of the analysis area (NMDGF 2019).

Additionally, three special status bat species (see AIB-8) and non-listed species have the potential to occur within the nominated lease parcels due to suitable foraging habitat; these species are only active during crepuscular foraging periods. Additionally, stipulation SENM-S-54-NSO is applied entirely to nominated lease parcel 370 and to portions of nominated lease parcel 6741 (see Appendices A and C) for LPC habitat, that may provide protection to general wildlife and game species.

The cumulative impact scenario in Section 3.3 provides a quantitative overview of cumulative actions within the analysis area. Past, present, and reasonably foreseeable future actions would result in a total of 427,740 acres of surface disturbance, of which the Proposed Action would comprise approximately 0.0003% (see Table 3.1) and would impact wildlife habitat. The past and future vegetation restoration projects outlined in Section 3.3 would have some countervailing impacts through reclaiming legacy well pads, roads, and caliche pits within the analysis area. Additionally, the NMDGF's Habitat Stamp Program is using reclaimed oil and gas development areas to construct wildlife water catchments to enhance habitat using revenue from the purchase of hunting licenses. Overall, the landscape habitat fragmentation and human presence are the long-term cumulative impacts for wildlife and present potential for a decline in species numbers or use of the analysis area.

AIB-16 Visual Resources

How would the visual landscape, including areas adjacent to Carlsbad Caverns National Park, be affected by future potential development of the nominated lease parcels?

Visual resources on BLM lands are managed using four Visual Resource Management (VRM) classes: VRM Class I, II, III, and IV (BLM 1986). Oil and gas development is not compatible with VRM Class I designated areas, is often not compatible with VRM Class II designated areas, is generally compatible with VRM Class III designated areas, and is compatible with VRM Class IV designated areas (BLM 1986).

All of the nominated lease parcels (5,942.36 acres) are entirely (100%) within VRM Class IV.
The objective of VRM Class IV is to provide for management activities that require major modifications of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements (BLM 1986).

Future potential development of the 32 nominated lease parcels would result in approximately 144 acres of surface disturbance, and approximately 32 wells. The BLM CFO reviewed aerial photography and records of existing oil and gas development to evaluate the nature and extent of visual impact as a result of lease and future potential development of nominated lease parcels. All 32 nominated lease parcels are adjacent to lands with a high degree of oil and gas development. Therefore, any future potential development of the parcels would be visually consistent with the surrounding landscape, which is already highly modified in character.

The three nearest nominated lease parcels to CCNP are approximately 41.37 miles (parcel 6740), 44.54 miles (parcel 6738), and 44.61 miles (parcel 363) northeast of CCNP, and 71.73 miles (parcel 6740), 74.93 miles (parcel 6738), and 75.29 miles (parcel 363) northeast of GUMO. Future potential development within these nominated lease parcels is not expected be visible from portions of CCNP or GUMO. The Hackberry Lake OHV recreation area is approximately 0.26 mile west of parcel 371 and 1.95 miles east of parcel 363. Concentrated existing development north, south, east, and west of these parcels may already be visible from the Hackberry Lake OHV recreation area; therefore, as development already exists, future potential development of these nominated lease parcels may contribute to impacts on the visual landscape of this area, however, this would not be a new impact.

Standard terms and conditions allow the BLM to consider further mitigation for visual resources at the time of proposed lease development. Measures could include siting of well sites, roads, and associated infrastructure to follow the contour of the landform, mimicking the lines in vegetation and to screen and hide locations. In addition, per Onshore Order 1 (OO1 - XII. Abandonment, B. Reclamation), interim reclamation (reclamation of surface disturbance not necessary for production) and final reclamation (reclamation following well plugging and abandonment) is required within 6 months of well completion and well plugging, respectively.

The cumulative impact scenario described in Section 3.3 provides a quantitative overview of cumulative actions within the analysis area. The RFFAs would create surface disturbances and visual contrasts with the surrounding landscape and adversely contribute to the existing scenic quality impacts on the analysis area's landscapes. The degree of impact would depend upon the location of proposed infrastructure relative to sensitive viewsheds and areas already highly modified in character. At the landscape level, vegetation rehabilitation efforts such as Restore New Mexico would continue, existing and active wells would be plugged and reclaimed to former visual condition, and a countervailing impact on visual resources would also occur.

AIB-17 Night Skies at Carlsbad Caverns National Park

How would future potential development of the lease parcels impact the quality of night skies at the Carlsbad Caverns National Park?

The darkness of the night sky is a valuable aspect of CCNP. Those who visit the park often seek an experience of solitude and the wilderness experience that dark night skies provide. Sky glow is the result of scattered artificial light in the atmosphere; it raises night sky luminance and creates the most visible negative effect of light pollution. The Sky Quality Index (SQI) is an index of light pollution from sky glow with a range of 0 to 100, where 100 is a sky free from artificial sky glow. Using the best available data, the National Park Service's (NPS's) Night Sky Monitoring Reports from 2008 indicate the SQI for the CCNP monitoring station within CCNP is between 89 and 91 (NPS 2016a). These values show that skies in the analysis area retain their natural characteristics throughout most of the sky. The SQI data have limitations that "bright unshielded lights in the land portion of the mosaic will not be accurately measured for two reasons: they commonly are so bright their recorded luminescence exceeds the dynamic range of the detector so they become clipped or saturated at the maximum ADU value, and the median filter will remove most of the light from these sources since they resemble stars or point sources" (NPS 2016a). The limitations of the SQI data indicate that point source lights from oil and gas development may not be completely accounted for.

The main sources of sky glow in the analysis area are the following: the communities of Artesia, Carlsbad, Roswell, Dexter, Hagerman, and Hobbs; artificial lighting associated with areas of consolidated oil and gas development (particularly at Loco Hills); and infrastructure lighting, flaring, and traffic. At present, there are approximately 41,006 active well bores of all well types in the tri-county analysis area (BLM 2019a).

Future potential development of the 32 nominated lease parcels could introduce additional artificial lighting that would contribute to sky glow. The degree to which artificial lighting contributes to sky glow would be generally temporary and transient in nature and would vary based on conditions such as cloud cover, weather, and wind speed or direction. For example, most artificial lighting would occur during the drilling, completion, and potential flaring of a well, which could last for approximately 45 to 60 days. Lighting from the other phases of development and production would occur from vehicle traffic or safety lighting. Given that the NPS reports that the primary sources that contribute to an increase in night sky effects (sky glow) are cities (NPS 2016b), contributions to sky glow from potential development of the 32 nominated lease parcels (32 horizontal wells) would be a small contribution to the existing sources.

Parcel 6740 is 41.37 miles northeast of, and most proximal to, the CCNP monitoring site and is 39.33 miles northeast of the CCNP park boundary. This parcel would introduce artificial lighting that would contribute to sky glow; however, due to the distance of this nominated lease parcel from the CCNP and concentrated existing oil and gas development currently visible from CCNP, impacts to sky glow from future potential development of the nominated lease parcels would be a small contribution to the existing sources.

Under standard terms and conditions, the BLM has the authority to require mitigation measures to reasonably reduce resource impacts at the lease development level. The BLM may require mitigation measures that specify flare shields, the type of lighting (limited to downcast lighting with covers for safety purposes only), and project alignment.

The cumulative impact scenario described in Section 3.3 provides a quantitative overview of cumulative actions within the analysis area. Cumulatively, while NPS monitoring data indicate that dark sky conditions in the area currently retain their natural characteristics, SQI ratings could be impacted by sky glow associated with community and urban growth, as well as reasonably foreseeable future oil and gas development (up to 16,000 wells over 20 years). Past, present, and reasonably foreseeable future actions would result in a total of 57,006 wells, of which the Proposed Action would comprise approximately 0.00006% (32 wells) (see Table 3.1).

AIB-18 Air Quality Related Values at Carlsbad Caverns National Park

How would future potential development of the nominated lease parcels impact air quality related values (visibility and deposition) at CCNP?

The analysis for this issue examines the Class I areas within the BLM CFO planning area. This area is chosen because these areas are afforded a higher level of protection under the Clean Air Act (CAA). The analysis considers oil and gas development within the CFO planning area as well as other sources outside of the planning area that might affect these Class I Air Quality Related Values (AQRVs).

Air Quality Related Values are resources sensitive to air quality and can include a wide variety of atmospheric-chemistry related indicators. Monitoring and modeling of AQRVs help to provide a level of protection to sensitive areas such as Class I park and wilderness areas. For purposes of this analysis, the following AQRVs have been considered: visibility, nitrogen deposition, and sulfur deposition.

Congress established certain national parks and wilderness areas as mandatory Class I areas where only a small amount of air quality degradation is allowed. Defined by the CAA, Class I areas include national parks greater than 6,000 acres, wilderness areas and national memorial parks greater than 5,000 acres, and international parks. These areas must have been in existence at the time the CAA was passed by Congress in August 1977. There are three Class I areas in or near the analysis area: Carlsbad Caverns National Park, GUMO, and Salt Creek Wilderness. The most closely watched Class I areas near the analysis area are CCNP and GUMO. GUMO has monitoring data representative of the CCNP. The NPS is responsible for managing the CCNP and the GUMO. The three nearest nominated lease parcels are 41.37 miles northeast (parcel 6740), 44.54 miles northeast (parcel 6738), and 44.61 miles northeast (parcel 363) of CCNP, and 71.73 miles (parcel 6740), 74.93 miles (parcel 6738), and 75.29 miles (parcel 363) northeast of GUMO.

Visibility[7]—Visibility modeling was performed using the BLM CFO RFD potential oil and gas well development scenario and with mitigation using EPA's on-the-books emission controls and additional management controls. This analysis tiers to the modeling that was performed in the Air Resources Technical Support Document (ARTSD; URS Group Inc. [URS] 2013) for the BLM CFO for results of visibility impairment indicating that for the Carlsbad region, visibility impacts on CCNP at the project level are minimal and not expected to be of concern for the CCNP (Engler and Cather 2012, 2014; URS 2013). The visibility screening analysis followed the recommendations in the Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report – Revised Guidelines (FLAG 2010). The analysis relies on a 0.5 and 1.0 delta-deciview (change in visibility) threshold, calculated for base year 2008, base case 2017, and future RFD years. Non-project, cumulative emissions are driving the overall visibility impacts. A refinement of the cumulative emissions would reduce the number of days of total visibility impacts and would likely be closer to baseline and future visibility impacts. Any refinement down to a smaller scope of development or project-specific level would likely reduce the number of days of total visibility impacts that would be likely closer to matching actual base and future visibility impacts/baseline conditions (URS 2013). Further refinement of the URS 2013 visibility modeled results was performed to show relative impacts. The results indicate that there are no days in which the threshold is exceeded at the project level for the CCNP.

Deposition[8]—Deposition modeling was performed using the BLM CFO RFD potential oil and gas well development scenario and with mitigation using EPA's on-the-books emission controls and additional management controls. This analysis tiers to the modeling that was performed in the ARTSD for results of nitrogen and sulfur deposition impairment (Engler and Cather 2012, 2014; URS 2013). To assess potential nitrogen and sulfur deposition impacts in the planning area, deposition impacts were compared to the NPS screening deposition analysis thresholds (DATs), which are defined as 0.005 kilogram per hectare per year (kg/ha/yr) in the western United States for both nitrogen and sulfur. A DAT is the additional amount of nitrogen or sulfur deposition within a Class I area, below which estimated impacts from a proposed new or modified source are considered to be insignificant. The DAT is a screening threshold that was developed primarily to assess impacts from a single stationary source (FLAG 2008, 2010). Modeling results showing deposition greater than a DAT do not strictly indicate the need for mitigation. If a DAT is exceeded, cumulative modeling may be required to demonstrate that cumulative deposition is below the level of concern (LOC). The LOC for the nitrogen and sulfur deposition values, defined by the NPS and U.S. Forest Service, is 3 kg/ha/yr for nitrogen and 5 kg/ha/yr for sulfur (Fox et al. 1989). Results of analysis showed that the maximum annual nitrogen DAT at the project level was exceeded for CCNP but may be below the LOC at specific receptors. Cumulatively, the LOC for nitrogen was found to be below the LOC value of 3 kg/ha/yr for CCNP (URS 2013). Both the maximum annual sulfur DAT at the project and cumulative level (not shown) were below the DAT and LOC thresholds, respectively, for CCNP. Deposition rates that are below the LOC are believed to cause no adverse impacts. Appendix R and Appendix S of the ARTSD provide detailed nitrogen deposition results for cumulative impacts (URS 2013). It should be noted that for a large aggregate project that includes thousands of sources (such as oil and gas development in the BLM CFO), deposition greater than the DAT is typical. For the lease parcels identified as being within closest proximity of the CCNP,

[7] Visibility impairment is a result of regional haze that is caused by the accumulation of pollutants from multiple sources in a region. Emissions from industrial and natural sources may undergo chemical changes in the atmosphere to form particles of a size that scatter or absorb light and result in reductions in visibility.

[8] Deposition of pollutants through direct or dry atmospheric transport and precipitation can result in acidification of water and soil resources in areas far removed from the source of the pollution, as well as in harm to terrestrial and aquatic species. The Acid Rain Program has resulted in greatly reduced levels of the most damaging pollutants. There are currently four wet deposition monitors in New Mexico: Gila Cliff Dwellings, Mayhill, Bandelier National Monument, and Capulin Volcano National Monument. Deposition data for nitrogen and sulfur deposition can be accessed through the National Atmospheric Deposition Program (NADP) website (NADP 2019).

degradation of air quality related to nitrogen deposition could occur, depending on the number of sources present during development and any mitigation applied.

As part of a master development plan for 436 oil and gas wells to be developed on over 106 well pads, Chevron conducted additional analysis extending the URS (2013) modeling that was performed in support of the CFO RMP effort and updated nitrogen oxide emissions in the project area. The results of acid deposition monitoring showed incremental exceedances of the nitrogen DAT of 0.005 kg/ha/yr in the CCNP during drilling operations but would be well below the DAT once drilling is completed (BLM 2016). Similar results of AQRVs can be expected for other large well development projects in the CFO. With consideration of these results, impacts future potential development of leases (nine wells in various locations across the CFO and which are not expected to be development concurrently) is not expected to show exceedances of the nitrogen DAT.

AIB-19 Cultural Resources

How would future potential development of the nominated lease parcels impact cultural resources?

The BLM CFO conducted a review of existing records and information for each lease parcel to identify historic properties, traditional cultural properties (TCPs), sacred sites, and traditional use areas within the area of potential effects (APE; the extent of the lease parcel boundaries) for the lease sale. The APE for physical effects is the physical footprint of the proposed parcels. This is to account for any potential development that may occur within the parcels at the APD stage. The proposed undertaking will not authorize any ground-disturbing activities; therefore, the APE for audible and visual effects is the same as the physical effects APE.

The BLM CFO cultural heritage staff reviewed existing information from the New Mexico Cultural Resource Information System (NMCRIS), internal BLM data sources, and General Land Office records to assess the effects of the proposed lease sale and the BLM's ability to avoid, minimize, or mitigate effects in later lease development. Approximately 3,799.02 acres (64%) of the 5,942.36 acres of the nominated lease parcels in the CFO have been inventoried for cultural resources, according to the record search. The review found eight previously recorded archaeological sites documented within the 32 nominated lease parcels. According to available records regarding the eight sites in the CFO, three sites are determined eligible for listing in the National Register of Historic Places (NRHP), and five sites are undetermined for listing in the NRHP, due to the potential for the sites to contain data important to understanding prehistory in the region. There are no known TCPs within the proposed parcels.

Due to partial archaeological survey coverage and minimal overall ground disturbance from development within the nominated CFO parcels, there is potential for identifying previously unrecorded sites. However, all parcels would be subject to additional analyses pursuant to NEPA and additional cultural resource analyses pursuant to 54 USC Section 300101 et seq., commonly known as the National Historic Preservation Act of 1966, as amended (NHPA), and 54 USC Section 306108, commonly known as Section 106 of the NHPA (Section 106) to include identification, effects assessment, consultation, and if necessary, resolution of adverse effects (mitigation, minimization, and/or avoidance), prior to the authorization of any ground-disturbing activities associated with the development of the oil and gas lease.

All nominated lease parcels assessed within this EA have been assigned the standard National WO-NHPA Lease Stipulation, which requires additional cultural resources analyses pursuant to Section 106 of the NHPA, to include identification, effects assessment, consultation, and if necessary, resolution of adverse effects, prior to the authorization of any ground-disturbing activities associated with the oil and gas lease. Additionally, all nominated lease parcels assessed within this EA have also been assigned Lease Notice NM-11-LN, which requires compliance with Section 106 of the NHPA and Executive Order 13007 (see Appendix C). In effect, this lease notice notifies lessees that the BLM could require intensive cultural

resource inventories, Native American consultation, and mitigation measures to avoid adverse effects—the costs for which would be borne by the lessee—and that the BLM may require modifications to or fail to authorize activities that are likely to adversely affect TCPs or sacred sites for which no mitigation measures are possible. The BLM would work with consulting parties to identify additional historic properties when an APD is received. The processing of lease development applications is a separate undertaking that would be analyzed through the Section 106 process at that time.

Based on the density of currently known historic properties and the fact that the proposed oil and gas lease sale does not directly authorize ground disturbance, the CFO cultural heritage resources specialists determined that there would be no historic properties affected at this time in the nominated lease parcels as a result of the proposed lease sale. Additionally, the CFO sent a letter notifying the New Mexico State Historic Preservation Office (SHPO) of CFO's intent to use the State Protocol Appendix C.I.a. on October 7, 2020. Please refer to Section 4.3 for additional details.

Additionally, the BLM CFO has also entered into the Permian Basin Programmatic Agreement (PBPA) as an option for compliance with Section 106 of the NHPA for energy-related projects in the Programmatic Agreement project area. Of the 32 parcels available for lease, 13 parcels (363, 366, 368, 369, 370, 371, 381, 382, 383, 384, 6738, 6740, and 6741) are within the PBPA area, and development on these parcels could comply with the provisions of the PBPA (BLM et al. 2016). See the Programmatic Agreement fact sheet for further information (BLM 2019d).

The cumulative impact scenario described in Section 3.3 provides a quantitative overview of cumulative actions within the analysis area. Such effects may include, but are not limited to, loss of or damage to cultural resources or contextual information (such as distribution of cultural resources) due to the development of oil and gas facilities and related industrial development, increased vehicular traffic, unauthorized ground disturbances, inadvertent oil spills, erosion, and unauthorized collection. The magnitude of cumulative impacts would generally depend upon the location of reasonably foreseeable development relative to the location of cultural resources and the degree to which the setting has already been impacted. Impacts from reasonably foreseeable development on federal lands or with a federal nexus would require separate NHPA processes to avoid, minimize, and/or mitigate effects on cultural resources.

AIB-20 Native American Concerns

How would future potential development on the nominated lease parcels impact Native American traditional cultural and religious concerns?

The BLM CFO initiated government-to-government consultation under NEPA and NHPA on August 24, 2020, as described in Section 4.2 of this EA. No specific Native American traditional cultural and religious concerns have been identified on the subject lease parcels. However, this consultation is considered ongoing. If the nominated lease parcels are leased, future potential development would go through separate NEPA and NHPA processes as directed by regulation and current policy.

The cumulative impact scenario described in Section 3.3 provides a quantitative overview of cumulative actions within the analysis area. Such effects may include, but are not limited to, loss of or damage to Native American religious use or gathering areas, or loss of access to these areas due to the development of oil and gas facilities and related industrial development, increased vehicular traffic, unauthorized ground disturbances, inadvertent oil spills, or erosion. The magnitude of cumulative impacts would generally depend upon the location of reasonably foreseeable development relative to areas of concern to Native Americans. Reasonably foreseeable development on federal lands or with a federal nexus would undergo the same type of consultation process discussed above.

AIB-21 Cave and Karst

How would the future potential development of the nominated lease parcels impact cave and karst resources?

Karst is a landscape produced by the dissolution of soluble rock types such as limestone, dolomite, marble, gypsum, or salt. Features associated with karst terrains include sinkholes or closed depressions, caves, dry valleys, sinking streams, and resurgences or springs. Sinkholes leading to underground voids and drainages are common. These features, as well as fissures and discontinuities in the bedrock, may serve as direct conduits leading to groundwater. Thus, surface and subsurface contaminants have the potential to be quickly transported into subterranean water systems and freshwater aquifers without filtration as a result of the development of oil and gas lease parcels. In addition, contaminants spilled or leaked into or onto karst zone surfaces and subsurfaces may lead to the disruption and displacement of cave species and critical biological processes. Changes in geologic formation integrity, runoff quantity/quality, drainage course, rainfall percolation factors, vegetation, surface contour, and other surface factors can negatively impact cave ecosystems and aquifer recharge processes. Heavy vibrations and focusing of surface drainages can lead to slow subsidence, collapse of subsurface voids, and/or cave ecosystem damage.

The BLM categorizes all areas within the CFO as having either low, medium, or high karst potential occurrence based on geology, occurrence of known caves, and density of known karst features (BLM 1997a, 2018b). All 32 of the nominated lease parcels are located entirely within the CFO's mapped low karst[9] occurrence zone. Stipulation SENM-S-54-NSO is applied entirely to nominated lease parcel 370 and to portions of nominated lease parcel 6741 (see Appendices A and C) for LPC habitat that may provide protection to cave and karst features if these features are found to be present during site specific surveys.

While there is a low likelihood of encountering karst features within the low karst occurrence zone, past oil and gas development in high and medium karst occurrence zones have resulted in the intersection of subterranean voids during construction, resulting in damage to equipment, loss of infrastructure, bit drops, and losses of drilling medium and cement during drilling and casing, respectively. Losses of circulation during drilling and cementing introduces foreign materials into the subterranean environment, while the opening of subterranean voids could change airflow patterns within a cave system that negatively impact the cave ecosystem and compromise the structural integrity of the cave passage. In the past year, the BLM CFO has received eight reports of subsurface voids opening during construction (power line, pipeline, and facility pad) and exploration activities (two seismic surveys) in areas where there were no previously known sinkholes or caves. None of these events resulted in reported contamination events of groundwater and the features impacted did not meet the criteria of a "significant cave;" thus, development remained in conformance with the Cave Resource Protection Act of 1988, and attendant regulations.

All future potential development within low karst occurrence zones on these parcels would be further reviewed and mitigated at the time of proposed lease development, or during other proposed ground-disturbing activities, per standard terms and conditions of the lease. While several mitigation measures can be implemented to mitigate many impacts, it is still possible for impacts to occur from containment failures, well blowouts, accidents, spills, and structural collapses. It is therefore necessary to implement long-term monitoring studies to determine if current mitigation measures are sufficient to prevent long-term or cumulative impacts on cave/karst resources. Mitigation measures could include changes in

[9] Low karst occurrence zones are areas that do not have soluble bedrock within 300 feet of the surface. Occasional features, such as breccia pipes, may occur within these areas related to karst at depth. There may also be pseudo-karst features due to soil piping and other natural or human-made processes that may present construction hazards but are not related to groundwater recharge (BLM 1997, 2018b).

drilling operations, special casing and cementing programs, installation of leak detection and automatic shut-off systems, and modifications in surface activities. A complete list of mitigation measures can be found in Appendix 3, Practices for Oil and Gas Drilling and Production in Cave and Karst Areas, within the Carlsbad RMP (BLM 1997a). Therefore, although cave/karst resources may experience impacts, the degree and extent of impacts are not expected to exceed a threshold of significance and the Proposed Action is expected to remain in conformance with the Cave Resource Protection Act of 1988, and attendant regulations.

Effects from reasonably foreseeable development are anticipated to be the same as the effects documented above. Future potential development of the nominated lease parcels would contribute less than 1%, incrementally, to the combined effects of past, present, and reasonably foreseeable future actions (see Section 3.3).

AIB-22 Playas

How would future potential development of the parcels affect function of playa features in these locations?

Playas are relatively small, round, shallow depressions. Their basins are lined with clay soil, which collects and holds water from rainfall and runoff, creating temporary lakes. Properly functioning playas have intact clay basins, are encompassed by grassy buffer strips or prairie, and collect water runoff from the surrounding area after large rain events. Despite their small size and relatively simple structure, playas are relevant to the landscape because they provide important ecological and hydrological functions. In this grassland landscape, playas are the main source of water and are the center of biodiversity on the plains—supporting 185 bird species, 450 plant species, 13 amphibian species, and 37 mammal species at some point in their life cycle (Smith 2003). They are important because they are a source for migratory and wintering shorebirds, waterfowl, and other game and nongame wildlife, and contribute to groundwater recharge. Past development in southeast New Mexico has resulted in disturbance to one-third of wetlands (Fretwell et al. 1996).

Culturally accelerated dust and sediment accumulation, which is the result of increased transport of dust and sediments from the upland through airborne particles and water erosion, could degrade function of the playa features. Land disturbances near a playa exacerbate the accelerated sedimentation problem: 1) through movement of sediments into the playa basin, and 2) through mixing of sediments with the underlying clay layer. The additional sediments may interfere with the shrinking and swelling of the clay layer, which is vital to aquifer recharge, and reduce playa volume which decreases hydroperiod. Hydroperiod reduction greatly alters the plant and wildlife community supported by the playa (LaGrange et al. 2011). Oil and gas operations could result in land disturbance within the drainage basin that would introduce sediments through erosion from heavy rains or wind. Additional sediments can fill the playa, preventing water from pooling and reducing the capacity of the playa to recharge an aquifer (Gurdak and Roe 2009). Spills can occur as a result of development (see Water Support Document [BLM 2019b] for discussion of spills) resulting in degraded playa function. There are no methods for remediation that would not disrupt the hydrologic connectivity, natural hydrology, and benefits that playas provide to wildlife within the planning area.

Based on desktop aerial photography, the USGS National Hydrography Dataset (USGS 2020a), FEMA floodplain data (FEMA 2020), USFWS National Wetland Inventory data (USFWS 2020b), a field visit conducted by the BLM in May 2020, and internal communication with the BLM CFO interdisciplinary team, it was confirmed playas are located within eight of the 32 nominated lease parcels (parcels 372, 375, 376, 378, 381, 386, 387, and 388) and comprise between 0.07% and 8.31% of the parcels in which they occur. Additionally, playas have been identified within 656 feet (200 m) of nominated lease parcels 371, 374, 389, 398, and 6740.

Stipulation SENM-S-19, which provides protections to playas and does not allow surface disturbance within 200 m of these areas, has also been applied to nominated lease parcels 371, 372, 374, 375, 376, 378, 381, 386, 387, 388, 389, 398, and 6740. The BLM has the authority under standard terms and conditions to attach COAs at the site-specific level to minimize adverse impacts on resource values at the time operations are proposed. Standard terms and conditions would allow for measures to avoid and mitigate accelerated soil erosion and sedimentation to water bodies. With consideration of standard terms and conditions, the stipulation, and as determined by the BLM Authorized Officer, all permanent impacts from surface occupancy to any playa features identified at the site-specific level would be avoided.

The cumulative impact scenario described in Section 3.3 provides a quantitative overview of cumulative actions within the tri-county analysis area. Portions of the resulting acreage impacts across the landscape could occur in leases that include or are in close proximity to playas. It is anticipated that CSU stipulations would also apply to reasonably foreseeable development, as needed to protect surface water and playa features, and the BLM would attach COAs at the site-specific level to minimize adverse impacts on resource values at the time operations are proposed.

AIB-23 Human Health and Safety

How would future potential development of the nominated lease parcels contribute risks to human health and safety?

Within the tri-county analysis area, there are 41,006 existing active well bores of all well types across all land jurisdictions (PRRC 2020). That level of development has resulted in the following public health and safety–related risks: occasional fire starts; spills of hazardous materials, hydrocarbons, produced water, or hydraulic fracturing fluid (see Appendix D) and corresponding potential contamination of air, soil, or water; traffic congestion and collisions from commercial vehicles and heavy use, especially south and east of Carlsbad along NM State Road 128 and U.S. Route 285; infrequent industrial accidents; presence of hydrogen sulfide (H_2S); or increased levels of fugitive dust (PM_{10}).

Future potential development on the nominated lease parcels is estimated to be 32 new wells for this lease sale. This is a 0.0008% increase in addition to the 41,006 existing active wells. When authorizing development, federal and state laws, regulations, and policy are applied to reduce effects or respond to incidents. These include the following:

- Federal, state, county, and municipal fire managers shall coordinate on fire response and mitigation.
- Developers who install and operate oil and gas wells, facilities, and pipelines are responsible for complying with the applicable laws and regulations governing hazardous materials and for following all hazardous spill response plans and stipulations. The NMOCD requires similar spill response measures after release of hydrocarbons, produced water, or hydraulic fracturing fluids (see Water Support Document [BLM 2019b] for further information on spills).
- All well pads, vehicles, and other workplaces must comply with worker safety laws as stipulated by the Occupational Safety and Health Administration (OSHA).
- Vehicular traffic and pipelines are regulated according to safety laws as stipulated by the Department of Transportation.
- Measures to lower risks related to H_2S exposure include flaring or venting gas and the use of stock tank vapor recovery systems.

In addition to fugitive dust, see the air quality analysis in Section 3.5.1 for potential health impacts of other air pollutants, including criteria pollutants, VOCs, and hazardous air pollutants (HAPs). See AIB-1

and AIB-2 for further information regarding potential surface and groundwater impact and relevant regulations, stipulations and lease notices offering protections to groundwater and surface water quality.

The U.S. Department of Energy's Waste Isolation Pilot Plant (WIPP) fenced property boundary is approximately 18.8 miles southwest of nominated lease parcel 384. The WIPP is insulated by a 16-section minerals withdrawal. The waste storage area is in the center of the withdrawal, and waste is encapsulated prior to transport and storage. In most areas around the WIPP, oil and gas wells would not directionally drill beneath the WIPP, as minerals are withdrawn in this area. On the southwest corner of the WIPP, existing oil and gas leases are located in areas where minerals have not been withdrawn and hydraulic fracturing has taken place within the WIPP boundary. The WIPP has multiple seismicity, waterflow, and air monitors on-site to detect adverse impacts related to oil and gas development near the WIPP, and no impacts have been detected. Additionally, the salt beds in which this project is located are tied to existing potash mining, and lease parcels are buffered to ensure active mining does not interfere with existing potash mining, which indirectly protects the WIPP. Finally, the BLM is required to notify the WIPP if an oil and gas well is to be located within 1 mile of the WIPP boundary and coordinate application of COAs. As a result of these protective measures, no impacts to the WIPP are expected from the Proposed Action.

The cumulative impact scenario described in Section 3.3 provides a quantitative overview of cumulative actions within the analysis area. While no formal human health risk assessments have been conducted specific to past and present development in the tri-county analysis area, results of EPA's 2014 National Air Toxics Assessment (NATA) indicate that cancer, neurological risks, and respiratory risks in the analysis area are generally lower than national levels (see Section 3.5.1.1). In addition to fugitive dust, see the air quality analysis in Section 3.5.1 for projected levels of criteria pollutants, HAPs, NAAQS, GHG emissions, and VOC and NO_x emissions that contribute to ozone formation.

Human health risk assessments for reasonably foreseeable future actions cannot be performed until project-specific details are known so that frequency, timing, and levels of contact with potential stressors may be identified (EPA 2020b). However, each of the past, present, and reasonably foreseeable future actions have been, or will be, subject to relevant rules and regulations regarding public health and safety. Ongoing and future potential development would continue to present cumulative risks to human health as detailed above. When wells reach the end of their useful life and are properly plugged and reclaimed, they would no longer contribute to these effects.

AIB-24 Socioeconomics

What are the potential impacts from oil and gas leasing and future potential development on socioeconomics?

While the act of leasing federal minerals itself would not result in direct social impacts, subsequent development of a lease may generate impacts on communities and individuals in the vicinity of the lease. At the lease sale stage, it is unknown where, or if, development would occur in any given nominated lease parcel; however, in general, acquisition and development of new leases provide local and regional jobs and revenue on a sustained basis. These may include employment opportunities related to the oil and gas and service support industries in the region, as well as federal, state, and county government revenue related to taxes, royalty payments, and other revenue streams. For example, the revenue collected from the lease sale auction is split between the U.S. Treasury and the state in which the auction is held and can be used for improvements to transportation networks and education systems. As specific types and locations of development are proposed, their impacts would be analyzed and addressed at the time of proposed lease development.

Oil and gas lease sales may contribute to employment for area residents, continued demand for oil and gas industry–related goods and services, and continued demand for support goods and services. This

continued demand may contribute to stability in employment in sectors outside of the oil and gas industry. To the extent that additional oil and gas development impacts affect recreational and tourism opportunities in the area of the nominated lease parcels, there may be related impacts in these economic sectors. Continued expansion of the oil and gas industry may be perceived as having a negative effect on quality-of-life considerations for people who value undeveloped landscapes, opportunities for isolation, and activities such as wildlife viewing and cattle ranching. The BLM uses a number of stipulations and lease notices applied to the nominated lease parcels in the current sale that may mitigate potential impacts on wildlife and other resources that in turn may mitigate impacts on related recreational and quality-of-life concerns (see Appendices A and C for specific stipulations and lease notices by nominated lease parcel, and individual stipulation and lease notice summaries).

The cumulative impact scenario described in Section 3.3 provides a quantitative overview of cumulative actions within the analysis area. The oil and gas industry has been a substantial contributor to the social setting and economic basis of the BLM CFO for decades. The oil and gas sector of the economy relies on both ongoing operational activities (development of existing leases) and new development opportunities (acquisition and development of new leases) to continue to provide local and regional jobs and revenue on a sustained basis. In the 9.3 million-acre tri-county analysis area, there are approximately 7 million acres of federal mineral estate. Overall development of federal fluid minerals comprises approximately 75% of total oil and gas development activities in the analysis area.

AIB-25 Quality of Life

How would future potential development of the nominated lease parcels affect quality of life and residences within and adjacent to the nominated lease parcels?

Future potential development of the nominated lease parcels includes activities that generate increased human activity, traffic, noise, dust, odor, light pollution, and visual impacts (see summary of the phases of oil and gas development in Appendix D). All of these activities have potential to affect quality of life of nearby residences, depending on the intensity of development activities and proximity of lease parcels to residences. Table 3.10 identifies residences nearest to the nominated lease parcels. While the majority of the impacts discussed in Table 3.10 would cease during operations, some residents would continue to experience visual or other impacts that have potential to affect quality of life if they are located in areas in which oil and gas development is not currently nearby or visible.

Table 3.10. Residential Areas in and near the Nominated Lease Parcels

Parcel Number (total parcel acreage)	Parcel Distance and Direction to Nearest Residence*	Parcel Closest to Nearest Municipality	Discussion*
392 (50.68)	0.01 mile, W	Parcel 392 is adjacent to the city of Lovington, NM.	Lands adjacent to parcel 392 are densely populated and mostly developed. Lands to the west, north, and northwest of parcel 392 are rural, moderately populated, and primarily consist of moderately concentrated oil and gas development. Lands to the S, E, NE, and SE are densely populated.

Parcel Number (total parcel acreage)	Parcel Distance and Direction to Nearest Residence*	Parcel Closest to Nearest Municipality	Discussion*
386 (160) 374 (80) 6742 (80) 387 (160) 376 (960) 372 (576.51) 388 (80) 389 (320) 379 (320) 378 (320)	386: 0.03 mile, E 374: 0.07 mile, W 6742: 0.33 mile, WSW 387: 0.52 mile, E 0.91 mile, NE 376: 0.91 miles, ENE 372: 1.44 miles, SE 388: 1.47 miles, SE 389: 2.08 miles, NE 379: 2.29 miles, NW 378: 2.65 miles, NW	Parcel 6742 is 8.79 miles SW of the city of Lovington, NM.	Lands adjacent to and in proximity of these nominated lease parcels are rural, sparsely populated, and mostly undeveloped for residential purposes and include little to no or sporadically concentrated oil and gas development and a network of roads. Parcel 376 abuts State Highway 457 and parcel 387 abuts U.S. Highway 82. Development in the vicinity of parcel 6742 includes agricultural lands, network of roads, and a large livestock facility 0.26 mile east of the parcel.
393 (154.57) 398 (160) 391 (640) 394 (718.98) 384 (240) 361 (80) 390 (40)	393: 0.01 mile, S 398: 0.32 mile, W 391: 0.51 mile, S 394: 0.82 mile, S 384: 0.9 mile, SE 361: 2.86 miles, NE 390: 4.33 miles, SW	Parcel 398 is 8.38 miles NW of the city of Hobbs, NM.	Lands adjacent to and in proximity of these nominated lease parcels are rural, sparsely populated, and mostly undeveloped for residential purposes and include sporadic to moderately concentrated oil and gas infrastructure and a network of roads. Development E of parcel 398 includes agricultural lands, and industrial uses. Parcel 398 is approximately 4.31 miles NW of Lea County Regional Airport. Laguna Tonto lake is approximately 1.83 miles SW of parcel 384.
380 (40) 375 (80) 381 (160)	380: 0.40 mile, SSW 375: 0.42 mile, NW 381: 1.37 miles, NW	Parcel 381 is 7.06 miles NE of the unincorporated community of Maljamar, NM.	Lands adjacent to and in proximity of these nominated lease parcels are rural, sparsely populated, and mostly undeveloped for residential purposes and include sporadically concentrated oil and gas development and a network of roads. Dense oil and gas development is located SW of parcel 381.
366 (80) 383 (80) 382 (42.3) 6740 (40) 369 (40) 371 (80) 368 (40) 370 (160) 6741 (320) 6738 (80) 363 (120)	366: 0.44 mile, NNW 383: 1.25 miles, E 382: 3.15 miles, SE 6740: 3.45 miles, SW 369: 3.93 miles, NE 371: 4 miles, SW 368: 5.24 miles, NE 370: 5.37 miles, NE 6741: 5.9 miles, NE 6738: 6.01 miles, NE 363: 6.26 miles, NE	Parcel 366 is 0.88 miles SE of the unincorporated community of Loco Hills, NM.	Lands adjacent to and in proximity of these nominated lease parcels are rural, mostly sparsely populated, and mostly undeveloped for residential purposes and include a network of roads and sparse to moderately concentrated oil and gas development. Densely concentrated oil and gas development is located within the vicinity of parcels 366, 382, 6741. Parcel 366 is approximately 0.37 mile SW of a residential community and 0.99 mile SE of a livestock facility. State Highway 529 bisects parcel 6741. Stipulation SENM-S-54-NSO is applied entirely to parcel 370 and to portions of parcel 6741 (see Appendices A and C) for LPC habitat that may provide protection to quality of life.

* Source: Google Earth (2020). For surface ownership of the parcels listed above, see Table 2.1 or Appendix A.

Future potential development of the nominated lease parcels is anticipated to be 32 horizontal wells (144 acres of surface disturbance). See Table 2.1 for total number of wells per nominated lease parcel. With consideration of total lease acreage, topography, and other resources issues present within the nominated lease parcels, there are opportunities for future potential development to reasonably be placed in portions of the nominated lease parcels that are less proximal to the residences to minimize quality of life issues. Under the authority granted in standard terms and conditions attached to each lease, measures to reduce impacts on or avoid resource values, land uses, or users would be attached as COAs to the APD. Under 43 CFR 3101-1-2, such reasonable measures may include modification to siting or design of facilities, including relocation of proposed operations up to 200 m. Site-specific avoidance, minimization, and/or mitigation measures would be determined at the time of proposed lease development. This could include measures to reduce noise, dust, odor, and light impacts during construction and operations.

The cumulative impact scenario described in Section 3.3 provides a quantitative overview of cumulative actions within the analysis area. Past, present, and reasonably foreseeable future actions would result in a total of 427,740 acres of surface disturbance, of which the Proposed Action would comprise approximately 0.02% (see Table 3.1). In consideration of past, present, and reasonably foreseeable future actions, cumulative noise, dust, odor, and light disturbances from oil and gas development and future residential and commercial development would impact the quality of life for the affected parcel residences and livestock facilities, and adjacent residences and livestock facilities. As with the Proposed Action, impacts to quality of life from RFFAs would be examined at the APD level with consideration of site-specific locational information and development of COAs to reduce impacts as needed.

AIB-26 Environmental Justice

What are the potential impacts from oil and gas leasing and future potential development on environmental justice populations?

Environmental justice (EJ) refers to the fair treatment and meaningful involvement of people of all races, cultures, and incomes with respect to the development, implementation, and enforcement of environmental laws, regulations, programs, and policies (CEQ 1997). Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* requires federal agencies to determine if proposed actions would have disproportionately high and adverse environmental impacts on minority, low-income, and American Indian populations of concern. BLM policy, as contained in BLM Land Use Planning Handbook H-1601-1 (BLM 2005) Appendix D, provides direction on how to fulfill agency responsibilities for Executive Order 12898.

The nominated lease parcels are located in Lea and Eddy Counties, New Mexico. These counties are used as the area of analysis for determining presence or absence of EJ populations of concern. The state of New Mexico is used as a comparison population for determining if low income[10] or minority[11] population percentages exceed the thresholds described by CEQ for consideration as EJ populations of concern. After examination of the most recently available data on minority and low-income populations for the area of analysis (U.S. Department of Commerce 2019), the BLM has determined that there are EJ populations of concern present.

For the purposes of this discussion, a minority or low income population is identified as an EJ population of concern if either (a) the minority population or low income population of the area of analysis exceeds 50% of the population, or (b) the minority or low income population percentage of the area of analysis is meaningfully greater than the minority or low income population percentage in the general population or other appropriate unit of geographic analysis (CEQ 1997:25). A minority population also exists “if there is more than one minority group present and the minority percentage, as calculated by aggregating all minority persons, meets one of the above-stated thresholds” (CEQ 1997:26). BLM New Mexico generally defines “significantly greater” as 10% above the average population size of the comparison geography.

Based on U.S. Census Bureau 2018 population estimates for race and Hispanic origin (U.S. Census Bureau 2019a), minority populations in Eddy and Lea Counties meet the criteria of being 50% or more of the population, and Lea County has minority populations that are greater than those of the State of New Mexico (Table 3.11). However, none of the minority populations in Lea County are significantly greater (i.e., ≥10% above) the state of New Mexico’s minority populations. Additionally, based on U.S. Census Bureau Small Area Income and Poverty 2018 estimates (U.S. Census Bureau 2019b), the percentage of

[10] Per CEQ guidance, low-income populations include individuals living below the poverty threshold, as identified by the U.S. Census Bureau (CEQ 1997).

[11] Per CEQ guidance, minority populations include individuals who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic (CEQ 1997).

the population in poverty did not meet thresholds (using the criteria of 50% or more of the population or 10% greater than the state of New Mexico) to be identified as EJ populations (see Table 3.11).

Table 3.11. Minority and Low-Income Populations by County in Area of Analysis

	Analysis Area		
	Lea County	**Eddy County**	**New Mexico**
Total Population of Analysis Area*	70,126	57,437	2,092,434
Minority Populations in Analysis Area	**Percent of Minority Populations in Analysis Area**		
Hispanic or Latino (of any race)	57.9%	48.4%	48.5%
Black or African American alone	3.6%	1.4%	1.8%
American Indian alone	0.7%	1.3%	8.8%
Asian alone	**0.2%**	**0.4%**	1.4%
Native Hawaii & Other Pacific Islander alone	0.0%	**0.0%**	0.0%
Some other race	**0.3%**	**0.1%**	0.2%
Two or more races	1.2%	0.8%	1.5%
Total Aggregate Minority Population†	63.9%	52.4%	62.2%
Poverty Prevalence in Area of Analysis	**Percent of Population Below Poverty Line in Analysis Area**		
Individuals Below Poverty Line	16.6%	15.3%	20.0%
Families Below Poverty Line	13.6%	12.1%	15.3%

Data Source: U.S. Department of Commerce (2019).

* American Community Survey 5-year estimates used. 2018 represents average characteristics from 2014 to 2018.

† Does not include "Not Hispanic or Latino" and "White alone" populations, since these are not considered minority populations per CEQ guidance (CEQ 1997).

All identified EJ populations should be provided opportunities to identify any perceived adverse environmental impacts. The determination of potential adverse and disproportionate impacts from specific actions may initially be the assessment of the BLM. This assessment should not be assumed to be the position of specific, potentially impacted, EJ populations. The BLM realizes that additional impacts may be identified by local EJ populations as specific development locations and types are proposed. As a result, this discussion assesses only the impacts for the issues identified by the BLM during scoping. The BLM should continue to work with potentially impacted EJ populations to identify and address additional EJ issues as they arise.

The federal government cannot dictate where oil and gas reserves may occur. Consequently, there may be instances where oil and gas exploration activities disproportionately and adversely impact EJ populations due to proximity and other factors, and for variable amounts of time. For example, a typical horizontal well averages from 30 to 60 days from start of drilling to completion (see Appendix D) and may have a greater impact (increased dust, traffic, etc.) on resident populations in close proximity to such drilling operations while the drilling operations are ongoing. These types of exploration activities may result in impacts that may be perceived as adverse by minority and low-income populations if the populations of concern are located near the drilling operations; however, the BLM does not know exactly where drilling operations may take place until lease development is proposed, if a nominated lease parcel is developed at all. The BLM CFO uses stipulations and COAs to minimize impacts to nearby populations, including minority and low-income populations, during operations, to the extent practicable.

As described in AIB-25, none of the nominated lease parcels contain residences, and 11 of the nominated lease parcels have residences within approximately 0.5 mile or less of the parcel boundary. All residences have the potential to be occupied by members of an EJ population. Standard terms and conditions attached as COAs to the APD could include measures to reduce effects on nearby residences. Under 43 CFR 3101-1-2, such reasonable measures may include modification to siting or design of facilities, including relocation of proposed operations up to 200 m.

For purposes of the leasing action, Table 3.12 provides a summary of the impact conclusions associated with the issues analyzed in detail. Those conclusions are then assessed, by BLM, relative to whether the projected impacts to EJ populations may be adverse and disproportionate.

Table 3.12. Summary Comparison of Conclusions from Analysis of Other Issues to Environmental Justice

Issues Analyzed*	**Summary of Potential Adverse Impacts**	**Are potential impacts disproportionate to environmental justice populations?**
Air Quality (Issue 1, Section 3.5.1)	NAAQS and VOC emissions would increase by up to 0.49% as a result of the Proposed Action. Future potential development of the lease parcels would result in short-term local area increases of pollutant emissions, particularly fugitive dust ($PM_{2.5}$ or PM_{10}), lasting an average of 30 to 60 days.	Potential for disproportionate impacts to EJ populations. While air quality is a regional resource felt by all communities in the area encompassed by the Proposed Action and development within the area, fugitive dust ($PM_{2.5}$ or PM_{10}) impacts would be felt more by the local residents during construction (likely to last 30 to 60 days), which may be part of an EJ population. Additional analysis would be conducted at the time of proposed lease development; standard design features and project-specific COAs would help to minimize potential effects that could be adverse and disproportionate.
Greenhouse Gases and Climate Change (Issue 2, Section 3.5.2)	Future potential development of the nominated lease parcels is estimated to result in 35,688 metric tons of carbon dioxide equivalent (CO_2e) from construction and operation and 4.04 million metric tons (MMT) of CO_2e from downstream GHG emissions. All GHG emissions would contribute to global GHG emissions. GHG emissions are associated with documented ongoing and reasonably foreseeable climate-related effects. For Upper Rio Grande Basin (southern Colorado to central southern New Mexico), these may include increased temperatures, decreases in overall water availability, and increases in frequency, intensity, and duration of both droughts and floods (BLM 2019b).	No. Any impact to climate change as described in the analysis would be regional in nature and would not be disproportionate to EJ populations.
Water Use, Quality, and Quantity (AIB-1, AIB-2, and Issue 3, Section 3.5.3)	Future potential development may require 998 AF of water (over 20 years) or 50 AF of water per year, which would increase the demand for surface and groundwater in Eddy and Lea Counties by 0.002%. With consideration of design features and regulatory requirements, no impacts to groundwater or surface water quality are expected from well drilling and completion. Spills affecting groundwater or surface waters could occur.	Potential for disproportionate impacts to EJ populations. While groundwater resources are regional in nature and water withdrawals are not anticipated to affect domestic water sources, any impacts on local water wells (for example, a spill that affects groundwater) could force residents to find other means of supplying water for domestic use. These residents may be members of an EJ population. Best management practices and COAs would help to minimize this risk. Should a spill occur, the BLM would work with the NMOCD to immediately remediate spills in accordance with federal and state standards, including 19.15.29.11 NMAC.

Issues Analyzed*	Summary of Potential Adverse Impacts	Are potential impacts disproportionate to environmental justice populations?
Dunes Sagebrush Lizard (DSL) and Lesser Prairie-Chicken (LPC) (Issue 4, Section 3.5.4)	Surface disturbance from future potential development of the nominated lease parcels would likely result in a decrease of habitat quality from human presence and loss of suitable habitat for DSL and LPC. Oil and gas–related traffic may result in direct mortalities. NSO and CSU stipulations and lease notices applied to the parcels in DSL and LPC habitat areas would assist in restricting and minimizing surface disturbance and minimizing impacts to both DSL and LPC.	No. Impacts to LPC and DSL habitat would have no effect on environmental justice or non-EJ populations.
Quality of Life (AIB-25)	As identified in AIB-25, future potential development of the nominated lease parcels could result in localized air, noise, visual resources, and traffic and safety impacts that could affect quality of life for local residences and EJ populations, particularly during construction. Continued expansion of the oil and gas industry may be perceived as having a negative effect on quality of life for people who value undeveloped landscapes.	Potential for disproportionate impacts to EJ populations. In general, quality of life impacts would be greater for the residents in close proximity to future potential development. These residents may be members of an EJ population. When evaluating siting of wells at the lease development stage, standard design features and project-specific COAs would be applied to reduce effects that could be adverse and disproportionate to EJ populations.

* The AIBs in Section 3.4 generally disclose adverse effects associated with these issues, some of which may be disproportionate to EJ populations based on where site-specific development occurs.

3.5 ISSUES ANALYZED IN DETAIL

The issues identified for detailed analysis in this EA were developed in accordance with CEQ regulations and the guidelines set forth in the BLM NEPA Handbook H-1790-1 (BLM 2008b) using input from internal and external scoping. Issues were retained for detailed analysis if that analysis is necessary to make a reasoned choice between alternatives; to determine significance; if there is disagreement about the best way to use a resource; or if there is conflict between resource impacts or uses.

3.5.1 Issue 1: Air Quality

How would future potential development of the nominated lease parcels impact air quality (particularly National Ambient Air Quality Standards and volatile organic compounds) in the tri-county 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. The presence of air pollutants is due to a number of different and widespread sources of emissions. The analysis area for this issue is the entirety of Lea, Eddy, 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. Much of the information in this section is incorporated from the *BLM 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 2019a).

3.5.1.1 *Affected Environment*

The CAA requires the EPA to set 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 2019a). The primary NAAQS are set at a level to protect public health, including the health of at-risk populations, with an adequate margin of safety (EPA 2019a).

The EPA has set NAAQS for six principal pollutants ("criteria" air pollutants): carbon monoxide (CO); nitrogen dioxide (NO_2); ozone (O_3); 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 2019b). 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.[12] 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 2019a).

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 ($\mu g/m^3$) 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 2019a).

Design values are the concentrations of air pollution at a specific monitoring site that can be compared to the NAAQS. The most recent design values for criteria pollutants within Eddy and Lea Counties are listed in Table 3.13 (EPA 2020c). These counties do not have monitoring data for CO, Pb, and PM_{10} concentrations, but because the counties are relatively rural, it is likely that these pollutants are not elevated.

Table 3.13. 2019 Design Values in Eddy and Lea Counties

Pollutant	2019 Design Values	Averaging Time	NAAQS	NMAAQS
O_3	0.079 ppm (Eddy County), 0.071 ppm (Lea County)	8-hour	0.070 ppm*	–
NO_2	5 ppb (Eddy County), 5 ppb (Lea County)	Annual	53 ppb†	50 ppb
NO_2	27 ppb (Eddy County), 35 ppb (Lea County)	1-hour	100 ppb‡	–
$PM_{2.5}$§	8.1 $\mu g/m^3$ (Lea County)	Annual	12 $\mu g/m^3$ §	–
$PM_{2.5}$§	16 $\mu g/m^3$ (Lea County)	24-hour	35 $\mu g/m^3$ ‡	–

Source: EPA (2020c).

Notes: NMAAQS = New Mexico Ambient Air Quality Standards; ppm = parts per million; ppb = parts per billion; µg/m3 = micrograms per cubic meter. While there are no NAAQS for hydrogen sulfide (H2S), New Mexico has set half-hour standards for H2S at 0.100 ppm within Pecos-Permian Air Quality Control Region and 0.030 ppm, for municipal boundaries and within 5 miles of municipalities with populations greater than 20,000 in the Pecos-Permian Air Quality Control Region (BLM 2019a). The NMAAQS standard for total suspended particulates, which was used as a comparison for PM10 and PM2.5, was repealed as of November 30, 2018.

* 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.

§ Annual mean, averaged over 3 years.

O_3 is the criteria pollutant that is of most concern for the tri-county analysis area. 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 nitrogen oxide(s) (NO_x) and

[12] 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.

volatile organic compounds (which are organic compounds that vaporize [i.e., become a gas] at room temperature) when exposed to sunlight (EPA 2019c). O_3 and NO_2 are criteria air pollutants and are regulated under the NAAQS and NMAAQS. VOCs are not criterial 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.

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 2019c). Breathing O_3 can have human health effects particularly for sensitive groups (children, the elderly, and those with chronic lung conditions like bronchitis, emphysema, and asthma) as well as sensitive vegetation (NMED 2019a). Major sources of emission for both NO_x and VOCs include industrial facilities like power plants and motor vehicle exhaust (including off-road equipment). Biogenic sources, such as trees and plants, can also represent a substantial portion of NO_x and VOC emissions in an area, including New Mexico (BLM 2019a).

In May 2020, the EPA published new design values for NAAQS for various counties throughout the United States. The 2811 Holland St monitoring station in Eddy County reported 8-hour ozone exceedances of 79 ppb (EPA 2020c). For the first time since monitoring began in 2009, Lea County O_3 concentrations exceeded the NAAQS threshold of 0.070 ppm with a reported 2019 O_3 design value of 0.071 ppm. These areas have not been formally declared non-attainment by the EPA through the State's recommendation. The BLM will continue to monitor these areas and participate in any ozone initiative meetings and strategies that the State recommends.

The Ozone Attainment Initiative is a project authorized by State Statute, 74-2-5.3 New Mexico Statutes Annotated 1978. This statute directs the NMED to develop plans that may include regulations more stringent than federal rules for areas of the state in which ambient monitoring shows ozone levels at or above 95% of the NAAQS.

NO_x is primarily emitted through fossil fuel combustion in electric utilities, high-temperature operations at other industrial sources, and the operation of motor vehicles (BLM 2019a). NO_x can also react with other chemicals in the air to form particulate matter, contributing to haze (BLM 2019a). VOCs also emitted from burning fuels (gasoline, wood, coal, or natural gas) and are associated with refineries, oil and gas production equipment, and other industrial processes. The upstream sources of VOCs that are produced during the production of oil and gas are during the separation of gases from liquids and the storage process. Such emissions are generally controlled with the use of enclosed combustion devices, such as flares. Leaks and ineffective control systems are also a source of VOC emissions. In the event that VOCs are produced from incomplete combustion, they become more highly reactive ozone precursors (Matichuk et al. 2016).

Particulate matter (also known as particle pollution) is a mixture of solid particles and liquid droplets in the air. Particulate matter varies in size: PM_{10} refers to particulate matter 10 micrometers or less in diameter (commonly considered "dust"). $PM_{2.5}$ refers to particulate matter that measures 2.5 micrometers or less (i.e., fine particles), which are the main cause of reduced visibility (haze) in the United States (EPA 2019d). 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 (BLM 2019a) but does not regulate particles larger than 10 micrometers in diameter (such as sand and larger dust particles). PM_{10} are not currently monitored in the tri-county analysis area, and there are no areas of high concentrations that would warrant monitoring by the NMED. Like O_3, most 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 2019d). Particulate matter emissions often result from activities like construction, traffic on unpaved roads, fields, and wildfires (EPA 2019d).

Particulate matter is of heightened concern when emissions are near sensitive receptors, such as residences, because particulate matter can be present in higher concentrations in a localized area prior to settling or dispersion.

CRITERIA POLLUTANT EMISSIONS

Along with criteria pollutant concentrations as measured by air monitors, the EPA provides data on human-caused criteria pollutant emissions, expressed in tons per year or total volume of pollutant released into the atmosphere. Human-caused emissions data point to which industries and/or practices are contributing the most to the general level of pollution (BLM 2019a). Total human-caused emissions within the tri-county analysis area are reported in Table 3.14, based on 2014 National Emissions Inventory (NEI) in tons per year (EPA 2014a).

The primary sources of air pollution in the Carlsbad Field Office are dust from blowing wind on disturbed or exposed soil, exhaust emissions from motorized equipment, oil and gas development, agriculture, and industrial sources. Table 3.14 shows total human-caused emissions for each of the counties in the PDO based on EPA's 2014 emissions inventory in tons/year (EPA 2014a). The Western States Air Resources Council-Western Regional Air Partnership (WESTAR-WRAP) conducted an oil and gas emissions inventory report for base year 2014 to further clarify the contributions of oil and gas activities to human-caused emissions within the Permian and San Juan Basins. The results indicate there are non-point sources, including fugitive components, pneumatic devices, pumps, and well blowdown events that may not be reported through the state and federal inventories. These nonpoint sources could represent greater criteria, HAPs, and GHG emissions within these basins, in particular VOC and NOx emissions that contribute to ozone formation. It is therefore believed that the NEI (EPA 2014a) data in Table 3.14 related to petroleum and related industries are underreported in terms of VOC and NOx emissions. Table 3.14 provides a comparison of the NEI and WESTAR-WRAP data sets. As shown in Table 3.14, a comparison of data sets indicates that oil and gas development–related NOx and VOC emissions may be underreported by approximately 59.4% and 11.2%, respectively.

Table 3.14. Human-Caused Emissions in the New Mexico Portion of the Permian Basin, in Tons per Year

County (Chaves, Eddy, and Lea)	NO_X	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2
2014 NEI—all sources, all counties*	29,482	50,226	115,793	46,627	7,067	7,422
2014 NEI Chaves County all sources*	3,410	11,093	6,304	15,833	2,134	72
2014 NEI Eddy County all sources*	10,368	19,933	56,492	16,350	2,696	1,798
2014 NEI Lea County all sources*	15,704	19,201	52,997	14,445	2,237	5,552
2014 NEI—petroleum and related industries, all counties*	12,327	–	108,065	–	–	–
WESTAR-WRAP 2014 oil and gas sources†	30,351	–	121,644	–	–	–

* Sources: EPA (2014a); Ramboll Environ (2017). Data pulled from NEI as of December 2019 from EPA (2014a). Values may not always sum correctly if queried on demand as the NEI database updates its emissions periodically with newer emission information. Values include Tier 1 summaries for each county, including combustion, industrial, on-road/nonroad, and miscellaneous sectors. Biogenic sources are not included.

† WESTAR-WRAP data include Roosevelt County emissions; 133 tons per year of NOx emissions and 374 tons per year VOCs. Only precursor pollutants to ozone formation are compared in this analysis (NOx and VOC).

AIR QUALITY INDEX

Air quality in a given region can also be measured by its Air Quality Index (AQI) value. The AQI is used to report daily air quality information in an easy-to-understand way by explaining how local air quality relates to human health. Calculated by the EPA, the AQI considers the following: O_3, particulate matter ($PM_{2.5}$ and PM_{10}), NO_2, SO_2, and CO (all except Pb). According to the EPA, O_3 and particulate matter,

both calculated daily for the AQI, are the two air pollutants that pose the greatest threat to human health (EPA 2018a).

The AQI translates daily air quality data into a tiered, color-coded system that helps people understand how clean outdoor air is, who may be affected if pollutant levels are higher than desired, and when individuals may want to take measures to protect their own health. The higher the AQI value, the greater the level of air pollution and the greater the concern for public health. An AQI value of 100 typically corresponds to the NAAQS set for that pollutant, and values below 100 are considered satisfactory for public health. Table 3.15 presents the AQI values (with associated color category) and levels of health concern.

Table 3.15. Air Quality Index

AQI Values	Levels of Health Concern	Meaning
0 to 50 (green)	Good	Air quality is considered satisfactory, and air pollution poses little or no risk.
51 to 100 (yellow)	Moderate	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
101 to 150 (orange)	Unhealthy for sensitive groups	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
151 to 200 (red)	Unhealthy	Everyone may begin to experience health effects and members of sensitive groups may experience more than serious health effects.
201 to 300 (purple)	Very unhealthy	Health alert: everyone may experience more serious health effects.
301 to 500 (maroon)	Hazardous	Health warnings of emergency conditions. The entire population is more likely to be affected.

Source: EPA (2018a).

Note: AQI values above 500 are considered beyond the AQI and represent extreme levels of particle pollution.

The AQI summary report (EPA 2018a) provides annual summary information, including maximum AQI values and count of days in each AQI category. Table 3.16 lists the number of days in which the AQI was "unhealthy for sensitive groups" or worse for the past 11 years. Over the past 10 years, Eddy County shows an upward trend in maximum AQI while Lea County show no significant trends in maximum AQI.

Table 3.16. AQI Summary Data for Number of Days Classified above 100 for the Analysis Area (2008–2019)

Location	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Eddy County	9	2	2	7	10	2	4	0	0	10	20	19
Lea County	0	3	0	7	1	2	3	1	0	4	6	4

Source: EPA (2020d).

Note: Data from Chaves County are available for less than one-third of the year, and therefore, the data from this site are not included to avoid providing misleading information due to incomplete data. However, based on the Chavez County data that are available, the number of days with AQI over 100 is one or fewer for each of the years represented. Data for Roosevelt County are not directly available; however, information from nearby counties are representative

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 EPA as a compound that is known or suspected to cause cancer or other

serious health effects and/or adverse environmental effects. There are currently 187 compounds listed as HAPs by the EPA. National Emission Standards for Hazardous Air Pollutants (NESHAPs), established by the EPA, limit the release of specified HAPs from specific industries (BLM 2019a). 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 2019a). The CAA defines a major source for HAPs as being one that emits 10 tons per year of any single HAP or 25 tons per year of any combination of HAPs. Under state regulations, a construction or operating permit may be required for a major source, and for New Mexico, determining a major source requires consideration of each oil and gas exploration and production well individually (BLM 2019a). In New Mexico, regulations for major sources are found under NMAC 20.2.70 and 20.2.71.

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 2019a). The NATA, published by the EPA, provides a tool by which to help focus emissions reductions strategies. The most recent NATA was completed for 2014 and was released in August 2018 (EPA 2014b). The 2014 NATA models ambient concentrations and estimates exposures and risk of cancer and/or other health impacts from HAPs, represented as risk hazard indices for cancer, neurological problems, and respiratory problems for each county and census tract (BLM 2019a). NATA cannot give precise exposures and risks for a specific individual; therefore, NATA data are best applied to larger areas. NATA derives concentration and risk estimates from emissions data from a single year and assumes a person breathes these emissions each year over a lifetime (approximately 70 years). Lastly, NATA only considers health impacts from breathing air toxics and does not take into account indoor hazards, contacting or ingesting these air toxics, or other ways in which people may be exposed (BLM2019a). A review of the results of the 2014 NATA shows that cancer, neurological risks, and respiratory risks in the analysis area are generally lower than national levels of 31.7 cases per 1 million people. The 2014 NATA map application reveals that the cancer risk index (defined as the probability of contracting cancer over the course of a lifetime [70 years], assuming continuous exposure) from human-caused emissions of HAPs in most of the analysis area is approximately 25 to 28 (that is 25 to 28 cases per 1 million people). The total cancer risk is 24.7, 25.9, and 28.0 for Lea, Chaves, and Eddy Counties, respectively (BLM 2019a).

3.5.1.2 *Environmental Impacts*

METHODOLOGY AND ASSUMPTIONS

Methodology and assumptions for calculating air pollutant emissions and developing inputs for the calculators are described in the Air Resources Technical Report (BLM 2019a). Emissions calculators were developed by air quality specialists at the BLM National Operations Center in Denver, Colorado, and account for a number of variables, including access and construction requirements, equipment, and other infrastructure needs, as well as expected production volumes. Because these calculators quantify emissions based on averages and several assumptions (e.g., construction methods, all wells would be hydraulically fractured), these estimates provide approximations of emissions of criteria pollutants, VOCs, and HAPs relative to regional and national levels. Additionally, the BLM in New Mexico has modified the calculators and assumptions for use in analyzing a single well to more closely represent oil and gas wells in the state and to address emissions from development and production for one horizontal well (BLM 2019a). Emissions estimates per well are included in Table 3.17.

IMPACTS ANALYSIS

Future potential development of the nominated lease parcels would include increased criteria pollutant emissions, including increased particulate matter released from new well pads or roads, exhaust emissions from drilling equipment, compressor engines, vehicles, flares, dehydration and separation facilities, and VOCs during drilling and production activities. As stated above, the most substantial criteria pollutants

and ozone precursors emitted by oil and gas development and production are VOCs, particulate matter, and NO_2.

Future potential development on the nominated lease parcels is estimated at approximately 32 horizontal wells across all nominated lease parcels (see Table 2.1 for a listing of the number of horizontal wells anticipated per parcel). While emissions under the Proposed Action reported in Table 3.17 remain a reasonable estimate of total emissions from future potential development, it is more likely that lease development activities and emissions would be spread out over time as a result of the varying development plans and approaches of lessees in the context of overall oil and gas development throughout the analysis area. Some parcels may not be developed at all.

Table 3.17. Percent Increase from Future Potential Development of the Lease Parcels

Future Potential Development	Lease Sale Emissions (tons per year)						
	PM_{10}	**$PM_{2.5}$**	**NOx**	**SO_2**	**CO**	**VOC**	**HAP**
Human-caused current emissions (Chaves, Eddy, and Lea Counties)	46,627	7,067	29,482	7,422	50,226	115,793	3,983
One oil-well emission factors*	0.58	0.27	4.53	0.12	2.06	4.46†	0.31
One gas-well emission factors*	0.67	0.33	5.53	0.11	1.87	0.77	0.06
Total emissions from lease sale (32 wells)	**18.56**	**8.64**	**144.96**	**3.84**	**65.92**	**142.72**	**9.92**
Percent increase	**0.04%**	**0.12%**	**0.49%**	**0.05%**	**0.13%**	**0.12%**	**0.25%**

* The emission estimates for a one-well (oil well) scenario include construction, operations, maintenance, and reclamation activities. Construction emissions include well pad construction (fugitive dust), heavy equipment combustive emissions, commuting vehicles, and wind erosion. Emissions from operations include well workover operations (exhaust and fugitive dust), well site visits for inspection and repair, recompletion traffic, water and oil tank traffic, venting, compression and well pumps, dehydrators, and compression station fugitives. Maintenance emissions for both oil and gas wells are for road travel, and reclamation emission activities are for interim and final activities and include truck traffic, a dozer, a blade, and track hoe equipment. The representative well used to calculate emissions is a horizontal oil well. Emissions for vertical wells were not used from this analysis due to current predominance in horizontal technological drilling methods and because presenting horizontal oil well emissions estimates represents a more conservative summary of emissions, compared with emissions from a vertical well, with the exception of SO_2, which could be four to five times greater in a vertical well scenario. However, sulfur dioxide emissions are still estimated to be within the same magnitude and less than 1 ton per year of SO_2 emissions per well. Oil wells are used for this analysis because they are the more prevalent well type in the PDO area. However, note that emissions of some compounds (NO_x, SO_2, PM_{10}, and $PM_{2.5}$) tend to be higher for gas well development in the area, but gas wells emit lower amounts of VOCs, CO, and HAPs.

† VOC emissions at the operational phase represent uncontrolled emissions and estimate potential emissions representing the contribution for "one oil well" from the emissions at storage tanks, gathering facilities, etc. However, federally enforceable regulations such as New Source Performance Standards (NSPS) OOOO and OOOOa both require emission reduction of VOC from well completions following hydraulic fracturing or refracturing and storage tanks with emissions greater than 6 tons per year after federally enforceable controls. Therefore, actual emissions from the one well scenario are likely be lower than represented.

This analysis assumes that all parcels would be developed concurrently. This assumption facilitates quantification in the analysis and provides a conservative estimate of maximum concurrent emissions as a result of leasing and future potential development of the nominated lease parcels. While emissions under the Proposed Action reported in Table 3.17 remain a reasonable estimate of total emissions from future potential development, it is more likely that lease development activities and emissions would be spread out over time as a result of the varying development plans and approaches of lessees in the context of overall oil and gas development throughout the analysis area. Some parcels may not be developed at all.

As shown in Table 3.17, emissions associated with concurrent development of 32 wells would range from 0.04% increase in PM_{10} to a 0.49% increase in NOx. Emissions are anticipated to be at their highest level during the construction and completion phases of implementation (approximately 30 days in duration) because these phases require the highest degree of earth-moving activity, heavy equipment use, and truck traffic, compared with the operations and maintenance phases of implementation. Emissions are

anticipated to decline during operations and maintenance as the need for earth-moving and heavy equipment declines.

VOCs and NO_2 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 NOx 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 3.17) from each of the wells would incrementally add to O_3 levels within the analysis area, which recently exceeded NAAQS in Eddy and Lea County. However, as noted above, all 32 wells would not necessarily be developed concurrently or even in a single year. Additionally, emissions would be spread out spatially because the nominated lease parcels would be located in two (Lea and Eddy) counties. Thus, given the spatial distribution and the overall number of wells to be developed as part of the Proposed Action, it is not expected that the Proposed Action would lead directly to additional NAAQS exceedances of O_3 in Eddy and Lea County. The Proposed Action is estimated to result in approximately 0.31 ton per year of HAP emissions from combined construction and operation of each well during the first year, which would be the highest anticipated annual rate of HAP emissions. The CAA defines a major source for HAPs to be one emitting 10 tons per year of any single HAP or 25 tons per year of any combination of HAPs (BLM 2019a). Emissions presented in this analysis conservatively represent uncontrolled emission rates prior to implementation of applicable federally enforceable controls. Therefore, it is not expected that the Proposed Action would be a major source of HAP emissions. Total HAP emissions from the Proposed Action are shown in Table 3.17, but these total emissions would be distributed over time and space.

Under the Proposed Action, particulate matter emissions (PM_{10} and $PM_{2.5}$) would increase by 0.04% and 0.12%, respectively. 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 ground work, 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. Impacts of 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 PM_{10} (dust) and other total suspended particulates (particles of sizes up to 50 micrometers) and therefore can impact local residents in the surrounding area (Araújo et al. 2014). None of the nominated lease parcels contain residences. The nearest residences are approximately 0.01 mile from parcel 392, and 0.01 mile from parcel 393 (see AIB-24 for full list of residences in proximity to the nominated lease parcels). However, the use of best management practices as described in Section 3.5.1.4 can reduce off-site impacts from fugitive dust.

The Proposed Action may also result in localized impacts to air quality at nearby residences due to ozone precursors and HAP emissions. A significant portion of the criteria pollutants, VOCs, and HAP emissions would be from construction and completion from future potential development of the nominated lease parcels; therefore, the Proposed Action would result in short-term increases in these emissions, lasting an average of 30 to 60 days. As stated above, air quality is dependent not only on the quantity of air pollutants, but also environmental conditions (humidity, wind direction and speed, temperature) that influence concentration and/or dispersion of pollutants. Ongoing operations of the well site would be subject to state and federal permitting (unless emissions are so minimal the site qualifies as de minimis), recordkeeping, monitoring, and reporting requirements, which ensure compliance with air quality emission standards.

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 a distance of approximately 300 feet (Zhu et al. 2002). The relatively

steep drop-off with distance of diesel particulate matter concentrations as well as the short duration of the activity make the impacts from exposure to HAP emissions minimal during construction. Additionally, HAP emissions from ongoing operations would be minimal on a per-well basis (0.31 ton per year per well).

Ongoing operations of the well site would be subject to state and federal permitting (unless emissions are so minimal the site qualifies as de minimis), recordkeeping, monitoring, and reporting requirements, which ensure compliance with air quality emission standards. Compliance with State and Federal permitting requirements are designed to ensure that a proposed source will not cause or contribute to a violation of NAAQS standards.

3.5.1.3 *Cumulative Impacts*

Current estimated emissions across the tri-county analysis area are reported above, and air quality across the tri-county analysis area is generally good based on AQI ratings over the last decade (see Table 3.16). Current estimated emissions and AQI ratings are reflective of the effects of past and present actions. While there are other sources of emissions in the PDO, oil and gas development is one of the most prominent sources of emissions. There are 41,006 active oil and gas wells in the New Mexico Permian Basin. Of this total, 18,690 wells are federal, with the remainder falling in other jurisdictions (PRRC 2020). Over the last 6 years, there have been 2,890 federal well completions in the Pecos District (Table 3.18).

Table 3.18. Past and Present Federal Well Completions

Number of Federal Well Completions	2014	2015	2016	2017	2018	2019
Pecos District	584	400	389	378	518	621

As with past and present actions, continued oil and gas development is the most prominent reasonably foreseeable future action affecting air quality in the PDO. The 2012 and 2014 RFD scenario estimates that there could be an additional 16,000 wells drilled by 2035, of which 6,400 would be federal (Engler and Cather 2012, 2014). The BLM Air Resources Technical Report (BLM 2019a) provides information related to the reasonably foreseeable development for the PDO planning area. Reasonably foreseeable development projected for a 20-year time period shows well development with an average of 800 wells per year (of which 320 would be federal). Annual well averages are multiplied by the one-gas well pollutant emission factor (see Table 3.17 emission factors) to calculate RFFA annual emissions for both federal well development and federal and non-federal well development associated with the RFD scenario in Year 2020 (Table 3.19).

The future potential development of the nominated lease parcels associated with the Proposed Action comprises 0.20% of the RFD scenario (16,000 wells) and assuming concurrent development, would be 4% of annual reasonably foreseeable development (800 wells). However, as noted above, it is uncertain whether the 32 horizontal wells under the Proposed Action would be developed concurrently or even in a single year. Past, present, and reasonably foreseeable future actions, including the Proposed Action, would incrementally contribute to cumulative increases in air quality emissions, with cumulative increases in criteria pollutants between 1% to 12.29% of existing annual emissions of all well development, federal and non-federal (see Table 3.19). As with the Proposed Action, emissions are anticipated to be at the most acute level during the construction and completion phases of implementation. Localized and short-term impacts on air quality for nearby residences from emissions of particulate matter, NOx, VOCs, and HAPs are expected; however, because well development varies (i.e., permit approval, well pad construction, spudding, and completion), the phases of development may not occur in

succession but may be spread out in development over time. As such, the incremental addition of criteria pollutants and VOCs would not be expected to result in any exceedances of the NAAQS or NMAAQS for any criteria pollutants in the analysis area.

Table 3.19. Air Emission from Annual Oil and Gas Well Development Associated with the RFD Scenario

Air Emissions	Lease Sale Emissions (tons per year)						
	PM_{10}	$PM_{2.5}$	NOx	SO_2	CO	VOC	HAPs
Human-caused emissions (Chaves, Eddy, and Lea Counties)	46,627	7,067	29,482	7,422	50,226	115,793	3,983
One oil-well emission factors*	0.58	0.27	4.53	0.12	2.06	4.46†	0.31
One gas-well emission factors	0.67	0.33	5.53	0.11	1.87	0.77	0.059
Total annual emissions for annual reasonably foreseeable federal well development (320 wells)	**185.60**	**86.40**	**1,449.60**	**38.40**	**659.20**	**1,427.20**	**99.20**
Percent increase	**0.40%**	**1.22%**	**4.92%**	**0.52%**	**1.31%**	**1.23%**	**2.49%**
Total annual emissions for annual reasonably foreseeable federal and non-federal well development (800 wells)	**464**	**216**	**3,624**	**96**	**1,648**	**3,568**	**248**
Percent increase	**1.00%**	**3.06%**	**12.29%**	**1.29%**	**3.28%**	**3.08%**	**6.23%**

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 gas well. Emissions for vertical wells were not used from this analysis due to current predominance in horizontal technological drilling methods and because presenting horizontal gas well emissions estimates represents a more conservative summary of emissions, compared with emissions from a vertical well, with the exception of SO_2, which could be four to five times greater in a vertical well scenario. However, sulfur dioxide emissions are still estimated to be within the same magnitude and less than 1 ton per year of SO_2 emissions per well. Oil wells are used for this analysis because they are the more prevalent well type in the PDO area. However, note that emissions of some compounds (NOx, SO_2, PM_{10}, and $PM_{2.5}$) tend to be higher for gas well development in the area, but gas wells emit lower amounts of VOCs, CO, and HAPs.

† VOC emissions at the operational phase represent uncontrolled emissions and estimate potential emissions representing the contribution for "one oil well" from the emissions at storage tanks, gathering facilities, etc. However, federally enforceable regulations such as New Source Performance Standards (NSPS) OOOO and OOOOa both require emission reduction of VOC from well completions following hydraulic fracturing or refracturing and storage tanks with emissions greater than 6 tons per year after federally enforceable controls. Therefore, actual emissions from the one well scenario are likely be lower than represented.

An Air Resources Technical Support Document (ARTSD; URS 2013) was prepared to analyze potential air quality impacts resulting from the RFD scenario. This effort included atmospheric dispersion and photochemical grid modeling to predict concentrations of specific pollutants in and around the BLM CFO (in which most of the Pecos District oil and gas activity occurs). The results of ARTSD analysis indicate that air quality impacts from the RFD scenario, while noticeable, are generally acceptable. Most predicted criteria pollutant concentrations are well below the NAAQS throughout the extensive modeling domains included in this analysis. While no exceedances of NAAQS were predicted from the modeling of federal wells associated with the RFD scenario (6,400 wells), consideration of the entire RFD scenario (16,000 wells) and other reasonably foreseeable future actions (i.e., cumulative impacts) in the ARTSD included predictions of pollutant concentrations approaching or exceeding the NAAQS (for ozone, $PM_{2.5}$ and potentially SO_2) and indicate the need for additional ambient monitoring data, refined modeling, and consideration of additional mitigation measures. Most of the areas where NAAQS would be exceeded are out of the BLM CFO region (URS 2013). The State of New Mexico is working on a plan to address ozone and air quality exceedances (NMED 2019a), including currently requiring operators to reduce NOx emissions.

3.5.1.4 *Mitigation Measures and Residual Effects*

Additional measures taken to comply with recent revisions to the EPA's Regional Haze Rule in January 2017 would further reduce pollutant emissions. The State of New Mexico will have to comply with these revisions as it develops its State Implementation Plan (SIP) for the second planning period. Implementation of Best Available Retrofit Technology for existing sources as set forth under the Regional Haze Rule should result in further improvements to visibility at the IMPROVE monitors in the BLM NMSO area of responsibility (BLM 2019a). These actions to improve visibility will also have the co-benefit of reducing criteria air pollutant emissions. Emissions may also be reduced through the NMED Air Quality Bureau's Ozone Attainment Initiative. The NMED is working on a SIP revision that outlines strategies and emissions control measures that are expected to improve air quality in the nearby area by May 8, 2021. The SIP would aim to implement these strategies to reduce NO_x and VOC emitted to the atmosphere in San Juan, Eddy, Lea, Rio Arriba, Sandoval, Valencia, and Dona Ana Counties (NMED 2019a).

The EPA has promulgated air quality regulations for completion of hydraulically fractured gas wells. These rules require air pollution mitigation measures that reduce the emissions of VOCs during gas well completions. Based on its authority under the standard terms and conditions, the BLM requires industry to incorporate and implement best management practices, which are designed to reduce impacts 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} (Intermountain Oil and Gas BMP Project 2013); 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; and performing interim reclamation to revegetate areas not required for production facilities and reduce the amount of fugitive dust.

In addition, the BLM 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 (EPA 2006).

Further, the EPA provides control measures for emission mitigation of various pollutants in the Menu of Control Measures (MCM). The MCM provides state, local, and tribal air agencies with information on existing emissions reduction measures, as well as relevant information concerning the efficiency and cost effectiveness of the measures. The MCM includes information on measures for large point sources of emissions, as well as some information on measures for nonpoint sources of emissions. State, local, and tribal agencies will be able to use this information in developing emissions reduction strategies, plans, and programs to assure they attain and maintain the NAAQS (EPA 2017a).

NOx reductions can include several control measures from oil and gas–related point sources. One such measure is selective catalytic reduction (SCR) for natural gas compressors. This control is the reduction of NOx through add-on controls. SCR controls are post-combustion control technologies based on the chemical reduction of nitrogen oxides (NOx) into molecular nitrogen (N_2) and water vapor (H_2O). The SCR utilizes a catalyst to increase the NOx removal efficiency, which allows the process to occur at lower temperatures. This control applies to compressors used in natural gas production operations, natural gas–fired and process gas–fired heaters with NOx emissions greater than 10 tons per year. This method generally offers an 80% control efficiency for NO_x (EPA 2017a).

Another NOx control measure for non-point sources is for process heaters using natural gas or process gas. This control is the use of low-NOx burner (LNB) technology to reduce NOx emissions. LNBs reduce the amount of NOx created from reaction between fuel nitrogen and oxygen by lowering the temperature of one combustion zone and reducing the amount of oxygen available in another. This control is applicable to natural gas–fired and process gas–fired process heaters with uncontrolled NOx emissions greater than 10 tons per year (EPA 2017a).

VOC control measures from oil and gas–related non-point sources include reducing emissions at storage tanks, use of flares, and a leak detection and repair program to capture fugitive emissions (leaks). The EPA has New Source Performance Standards (NSPS) in place, NSPS OOOO, to reduce VOCs from well completion operations and storage tanks constructed after August 23, 2011 (EPA 2017b). NSPS OOOOa requires reduction of VOCs from well completion operations and storage tanks, and imposes semiannual monitoring requirements for the collection of fugitive emission components at well sites constructed after September 18, 2015. Other emission controls of VOCs include vapor recovery units, enclosed combustors (vapor combustion unit), and open-tipped (candlestick flares). The most desirable control method is a vapor recovery unit since this recovers the natural gas production and sends the gas to the sales line or back to the process for facility use. Finally flaring helps to reduce 98% of VOC emissions at petroleum flares (EPA 2017b).

The specified emission control techniques have varying degrees of effectiveness as discussed above. Therefore, the mitigation measures applied to future potential development of the nominated lease parcels would reduce emissions of particulate matter and VOCs but would not completely eliminate these emissions. Emission control techniques would be further evaluated when specific lease development projects are proposed.

3.5.2 Issue 2: Greenhouse Gases and Climate Change

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

The analysis areas associated with this issue are the New Mexico portion of the Permian Basin, the state of New Mexico, the United States, and the globe. The different geographic scales are used in this analysis to provide a basis of comparison at multiple geographic scales to disclose the relative magnitude of GHG emissions as a result of leasing and future potential oil and gas development of the nominated lease parcels, which are located in the New Mexico portion of the Permian Basin. Comparison of the relative magnitude of impacts at various geographic scales is appropriate because, although the effects of GHG emissions are global in nature, each region experiences the impacts of climate change in different ways. Therefore, the analysis presents the relative magnitude of the Proposed Action to quantify and discuss the environmental effects in terms of GHG emissions.

The cumulative impacts section is broken into two parts. Firstly, lease sale activities within the jurisdiction of the BLM NMSO contribute cumulatively to overall GHG emissions. Therefore, lease sales within the states of New Mexico, Texas, Kansas, and Oklahoma, which are within the administrative jurisdiction of the BLM NMSO, are discussed, and the magnitude of emissions are presented. The potential energy resource development within this area is disclosed to provide context, and a summary of the degree of contribution from BLM NMSO leasing activities to global and national GHG emissions are presented to disclose the relative magnitude of emissions.

Secondly, because the impacts of GHG emissions are not localized to the area where they originate and the impact of GHG emissions are inherently cumulative, the impacts of climate change are presented in the cumulative impacts section. The contribution of the Proposed Action, as well as the cumulative actions of BLM NMSO, are inherently included in the cumulative GHG emissions that contribute to

global climate change impacts, and for completeness, the projected BLM energy leasing activities from 13 states that contribute most of the federal energy production and consumption are discussed within the context of global cumulative emissions. The anticipated cumulative impacts of climate change are discussed in terms of global impacts, impacts to the states of New Mexico, Texas, Oklahoma, and Kansas, and impacts to the New Mexico portion of the Permian Basin. This not only gives insight into the global nature of climate change impacts, but also provides more specific projections of impacts at the scale of the Proposed Action. Particularly, presenting the impacts in the New Mexico portion of the Permian Basin allows more intuitive and concrete assessment of the impacts of climate change in concert with other resource impacts of the Proposed Action to assist with a reasoned choice between alternatives based on a more comparable geographic scale.

3.5.2.1 *Affected Environment*

Climate change is a statistically significant and long-term change in climate patterns. The terms climate change and "global warming," though often used interchangeably, are not the same. Climate change is any deviation from the average climate via warming or cooling and can result from both natural and human (anthropogenic) sources. Natural contributors to climate change include fluctuations in solar radiation, volcanic eruptions, and plate tectonics. Global warming refers to the apparent warming of climate observed since the early twentieth century and is primarily attributed to human activities such as fossil fuel combustion, industrial processes, and land use changes.

Climate change is a global process that is affected by the sum total of GHGs in the Earth's atmosphere. The incremental contribution to global GHGs from a proposed land management action cannot be accurately translated into effects on climate change globally or in the area of any site-specific action. Currently, global climate models are unable to forecast local or regional effects on resources (Intergovernmental Panel on Climate Change [IPCC] 2013). However, there are general projections regarding potential impacts on natural resources and plant and animal species that may be attributed to climate change from GHG emissions over time; these effects are likely to be varied, including those in the southwestern United States (Karl 2009). Climate change projections are based on a hierarchy of climate models that range from simple to complex, coupled with comprehensive earth system models. Additional near-term warming is inevitable due to the thermal inertia of the oceans and ongoing GHG emissions.

The natural greenhouse effect is critical to the discussion of climate change. The greenhouse effect refers to the process by which GHGs in the atmosphere absorb heat energy radiated by Earth's surface. Water vapor is the most abundant GHG, followed by carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and several other trace gases. Each of these GHGs exhibit a particular "heat trapping" effect which causes additional heat retention in the atmosphere that would otherwise be radiated into space. The greenhouse effect is responsible for Earth's warm atmosphere and temperatures suitable for life on Earth. Different GHGs can have different effects on the Earth's warming due to their ability to absorb energy ("radiative efficiency"), and how long they stay in the atmosphere ("lifetime"). The Global Warming Potential (GWP) was developed to allow comparisons of the global warming impacts of different gases (EPA 2019h). Because some GHGs have a GWP greater than that of CO_2, the EPA uses measures of CO_2 equivalencies (CO_2e) to account for the difference in each GHG's GWP (BLM 2019a). Water vapor is often excluded from the discussion of GHGs and climate change since its atmospheric concentration is largely dependent upon temperature rather than human-related activities.

The two primary GHGs associated with the oil and gas industry are CO_2 and CH_4. CH_4 has a global warming potential that is 21 to 28 times greater than the warming potential of CO_2 over a 100-year timescale (BLM 2019a). Oil and gas field production activities do not substantially contribute to N_2O levels and are therefore not included in estimating potential emissions in this EA. Several different time horizons can express GWPs to fully account for the gases' ability to absorb infrared radiation (heat) over their atmospheric lifetime. The BLM uses the 100-year time horizon since most of the climate change

impacts derived from climate models are expressed toward the end of the century. Also, in accordance with international GHG reporting standards under the United Nations Framework Convention on Climate Change (UNFCCC) and in order to maintain consistent comparisons over the years, official GHG emission estimates for the United States are reported based on the GWP values given in the Fourth Assessment Report (AR4) of the IPCC.

A more detailed discussion of climate change and the relationship of GHGs to climate change, as well as the intensity and effects at different geographic contexts (i.e., basin-specific [Permian and San Juan], New Mexico, national, and global climate), is presented in the Air Resources Technical Report (BLM 2019a).

To summarize, findings indicate that warming of the climate system is unequivocal and many of the observed changes are unprecedented over decades to millennia. It is certain that global mean surface temperature has increased since the late nineteenth century and virtually certain that maximum and minimum temperatures over land have increased on a global scale since 1950. Human influence has been detected in warming of the atmosphere and the ocean, in changes in the global water cycle, in reductions in snow and ice, in global mean sea level rise, and in changes in some climate extremes. It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-twentieth century. Additional near-term warming is inevitable due to the thermal inertia of the oceans and ongoing GHG emissions. Worldwide, 2013 total global GHG emissions were 48,257 million metric tons (MMT) of CO_2e, including land-use change and forestry (Table 3.20). Energy consumption (electricity generation, manufacturing/construction, and transportation) account for roughly 31%, 13%, and 15% of total global GHG emissions, respectively (World Resources Institute 2017).

In the United States, 2017 national emissions totaled 6,457 MMT of CO_2e (see Table 3.20). Energy consumption (electricity production, commercial and residential, transportation, and industry) account for 27%, 8.2%, 28%, and 13% of total national GHG emissions, respectively, or 4,912 MMT (76.1%) of CO_2e. Other GHG contributions are from agriculture (9.9%) and land use and forestry (11.6%) (EPA 2019e). On a national scale, it is estimated that extraction and end-use combustion of fossil fuels produced on federal lands comprise less than 3% of global emissions and less than 20% of national emissions. In 2014, the U.S. federal lands provided 283.2 MMT of carbon storage on a national basis. U.S. federal lands sequestered an average of 195 MMT of CO_2e between 2005 and 2014, offsetting approximately 15% of the CO_2 emissions resulting from the extraction of fossil fuels on federal lands and their end use combustion (BLM 2019b).

Climate change will impact regions of the United States differently, and warming will not be equally distributed. The general trend for New Mexico over the past two decades has been increasing GHG emissions, due largely to increase in coal-based electricity generation and oil and natural gas production activities. In 2014, New Mexico federal lands provided 12 MMT of carbon storage. Federal lands in New Mexico sequestered an average of 9.5 MMT of CO2e between 2005 and 2014 (BLM 2019b).

Data indicate that in the region encompassing southern Colorado and New Mexico, which includes the New Mexico Portion of the Permian Basin where the Proposed Action will occur, average temperatures rose just under 0.7 degrees Fahrenheit per decade between 1971 and 2011, which is approximately double the global rate of temperature increase.

Table 3.20 shows estimated global emissions as well as GHG emissions for the United States, the states of Oklahoma, Kansas, Texas, and New Mexico, and the major oil and gas basins of New Mexico. Emissions are expressed in million metric tons CO_2e.

Table 3.20. Estimated Annual GHG Emissions

Annual GHG Emissions	Million Metric Tons per Year (MMT CO_2e)	% Global Emissions	% U.S. Emissions	% New Mexico Emissions
Global emissions, all sources*	48,257	100	N/A	N/A
U.S. emissions from all sources†	6,457	13	100	N/A
Oklahoma emissions‡	92.4	0.19	1.43	N/A
Kansas emissions‡	62.5	0.13	0.97	N/A
Texas emissions‡	564.4	1.17	8.74	N/A
New Mexico emissions‡	101.7	0.21	1.58	100
San Juan Basin emissions§	23.7	0.05	0.37	23
Permian Basin emissions§	8.4	0.02	0.13	8

Note: The analysis contained in this table provides percentage contribution rounded to two decimal points. N/A – value not comparable at the same scale.

* As cited from World Resources Institute in BLM (2019a).

† EPA (2019e).

‡ NMED (2006).

§ EPA (2019f). State-level emission data in the table above include mobile source emission and prescribed burning emission data from EPA's 2014 National Emissions Inventory (NEI) data, which are the most recent available national emission inventory data for these area sources of GHG emissions. These area source GHG emission values are added to the most recently available data from EPA's Facility Level Information on Greenhouse Gases Tool (FLIGHT) for the 2018 reporting period. EPA's FLIGHT data include GHG emissions from large stationary sources which are required by 40 CFR 98 to report their emissions. Note that the reporting requirements of 40 CFR 98 applies only to large suppliers of GHG emitting products or facilities in certain sectors that emit more than 25,000 metric tons of CO2e per year. Note that agricultural and land use sectors are not required to report, and the data exclude smaller stationary sources of GHG emissions. The EPA estimates that the GHG emissions reported to the EPA through the mandatory reporting program for large stationary sources encompass approximately 85% to 90% of total U.S. GHG emissions from stationary sources.

Emissions from oil and gas field activities across the United States is 169.4 MMT of CO_2e (not displayed in above table). The source for the data is EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2017 Tables 3-37, 3-39, 3-41 (Petroleum Systems) and Tables 3-64, 3-67, 3-69 (Natural Gas Systems). Values for Exploration and Production Field Operations from these tables in the EPA's Sources and Sinks document are summed together to obtained one CO_2e value (169.4 MMT) and represent U.S. emissions from oil and gas activities.

Sources of GHG emission data have various limitations and uncertainties. The data shown in Table 3.20 include data collected and verified by the EPA. However, other sources of GHG data result in different estimates. For instance, the World Resources Institute is a nongovernmental organization that compiles dozens of different data sets to estimate historical GHG emission data, including from the U.S. Census Bureau, the U.S. Department of Commerce, and the EPA. The World Resources Institute 2014 CAIT 2.0 report shows that estimated GHG emissions were 77.69, 145.14, 110.38, and 873.80 MMT CO_2e for New Mexico, Oklahoma, Kansas, and Texas, respectively (World Resources Institute 2017), based on 2014 calendar year data.

3.5.2.2 *Environmental Impacts*

The following analysis quantifies emissions associated with lease parcel development (i.e., construction and operation of the 32 horizontal wells predicted for the nominated leases) and discloses the contribution of these emissions in relation to basin, state, and national emissions. The analysis also discloses as production (downstream or end use) emissions, which are based on projected oil and gas production volumes. Note that the BLM does not direct or regulate the end use of produced oil and/or gas.
An analysis of the social cost of carbon is not included because 1) it is not engaged in a rulemaking for which the protocol was originally developed; 2) the Interagency Working Group (IWG), technical supporting documents (IWG 2010), and associated guidance have been withdrawn; 3) NEPA does not require cost-benefit analysis; and 4) the full social benefits of fossil fuel-fired energy production have not been monetized, and quantifying only the costs of GHG emissions but not the benefits would yield information that is both potentially inaccurate and not useful. See Appendix E for further explanation.
The Proposed Action's GHG emissions contribute to GHG concentrations in the atmosphere, which

cumulatively result in climate change impacts. The impacts of climate change on the multi-county analysis area are inherently cumulative and are discussed in the cumulative climate change impacts section.

WELL DEVELOPMENT (CONSTRUCTION AND OPERATIONS)

The BLM has determined that in the PDO, construction of an oil well would result in a total of 383.67 metric tons CO_2e, and construction of a gas well would result in a total of 1,021.59 metric tons CO_2e. The emissions difference between well types is largely associated with the need to vent during the well completion stage. Emission activities from operations include well workover operations, well site visits for inspection and repair, recompletion traffic, water and oil tank traffic, venting, compression and well pumps, dehydrators, and compression station fugitives. Operations of an oil well in the PDO is estimated to result in 96.94 metric tons CO_2e annually; operation of a gas well would result in 93.67 metric tons CO_2e annually.

Table 3.21 presents annual emissions associated with historical federal well completions. Over the last 5 years, there have been 2,269 new federal well completions in the Pecos District. Annual completions range from 378 to 584, for an average of 454 well completions resulting in approximately 506,333 metric tons CO_2e (BLM 2019a).

Table 3.21. Historical Oil and Gas Well Completions in the Pecos District

Number of Well Completions	2014	2015	2016	2017	2018	5-year average
Carlsbad Field Office	384	238	141	184	238	237
Roswell Field Office	7	1	4	2	8	4.4
Hobbs Field Office	193	161	244	192	272	212
Total	**584**	**400**	**389**	**378**	**518**	**454**
Metric tons CO_2e/year	651,318	446,108	433,840	421,572	577,710	506,333

Source: BLM AFMSS Data as reported in BLM 2019a.

Note: Emission totals are calculated using gas well emissions factors of 1,021.59 metric tons CO2e for construction and 93.68 metric tons CO2e for operations. The one-well emissions from construction and operation of a gas well represent the higher of the single well emissions estimates both in terms of maximum annual emission rate from construction and operation per well and total single well emissions over the 20 year time frame set forth in the RFD.

Table 3.22 presents GHG emissions associated with lease development assuming full development of the nominated lease parcels (32 horizontal wells). Because it is not yet known whether the wells would be oil or gas, the higher of the emissions estimates described above are used in the analysis.

As shown in Table 3.23, average annual GHG emissions over the last 5 years in the BLM PDO (which includes the oil and gas development associated with the New Mexico portion of the Permian Basin) comprised about 0.008% of all U.S. GHG emissions, 0.30% of U.S. oil and gas operations GHG emissions, 0. 498% of New Mexico GHG emissions, and 6.028% of Permian Basin GHG emissions. The future potential development of 32 horizontal wells on the nominated lease parcels would result in the following emissions:

- Construction: 32,691 metric tons CO_2e (0.00051% of all U.S. GHG emissions, 0.0193% of U.S. oil and gas operations GHG emissions, 0.032% of New Mexico GHG emissions, and 0.389% of Permian Basin GHG emissions), which would occur in year 1 only;
- Operations: 2,997 metric tons CO_2e (0.00005% of all U.S. GHG emissions. 0.0018% of U.S. oil and gas operations GHG emissions, 0.003% of New Mexico GHG emissions and 0.036% of Permian Basin GHG emissions), which would occur each year the well is in operation.

Table 3.22. Estimated Annual GHG Emissions from Future Potential Well Development of the Leases (Construction and Operations)

Annual GHG Emissions	Metric Tons (CO_2e)*	U.S. Emissions† (%)	U.S. Oil/Gas Operations† (%)	New Mexico Emissions‡ (%)	Permian Basin emissions§ (%)
Potential GHG emissions from well construction (32 wells, year 1 only)	32,690.72	0.00051%	0.0193%	0.032%	0.389%
Potential GHG emissions from well operation (32 wells) per year	2,997.44	0.00005%	0.0018%	0.003%	0.036%
Total	35,688.16	0.00055%	0.0211%	0.035%	0.425%
Average GHG emissions 2014–2018 Pecos District Planning Area*	506,333	0.008%	0.30%	0.498%	6.028%

* Emission totals are calculated using gas well emissions factors of 1,021.59 metric tons CO2e for construction and 93.68 metric tons CO2e for operations. The one-well emissions from construction and operation of a gas well represent the higher of the single well emissions estimates both in terms of maximum annual emission rate from construction and operation per well and total single well emissions over the 20 year time frame set forth in the RFD. Note that CO_2e values are derived based on uncontrolled emission rates of methane. This is highly conservative given that in accordance with 40 CFR Part 60 Subpart OOOOa, new hydraulically fractured wells require limitation of methane emissions and collections of fugitive emissions components at well sites are required to be monitored for leaks semi-annually and are subject to stringent repair and reinspection requirements. Maintenance and reclamation activities are not included in the GHG emission estimates, but these would be minimal and sporadic.

† 2017 emissions data, see EPA 2019e.

‡ NMED 2006.

§ 2014 EPA NEI data and 2018 EPA Greenhouse Gas Reporting Program emissions; see EPA 2019f and EPA 2019g.

Considered together, construction and operations of 32 horizontal wells would result in 35,688 metric tons CO_2e annually (0.00055% of all U.S. GHG emissions, 0.0211% U.S. oil and gas operations GHG emissions, 0.035% of New Mexico GHG emissions and 0.425% of Permian Basin GHG emissions (see Table 3.22). Note that this total is a maximum development scenario that assumes that 1) all wells would be constructed in the same year and that 2) operations would commence in the same year as construction. Lease development activities and emissions may be spread out over time as a result of the varying development plans and approaches of lessees in the context of overall oil and gas development throughout the analysis area, and some parcels may be not developed at all. If construction is spread out over multiple years, annual GHG emissions during those years would be lower than the total of 35,688 metric tons CO_2e that is reported in Table 3.22 but higher than the operations subtotal of 2,997 metric tons CO_2e. The total emissions from combined construction (during the first year) and operation over the 20-year time frame set forth in the RFDs would be 92,639.52 metric tons CO_2e. This estimate is based on all 32 horizontal wells being gas wells, which have a higher life-cycle emission total than oil wells.

PRODUCTION (DOWNSTREAM/END USE)

Estimates of production (or downstream/end use) GHG emissions are dependent on projected oil and gas production volumes. The BLM does not direct or regulate the end use of produced oil and/or gas. The challenge for estimating downstream emissions comes with understanding when and how oil and gas would be distributed and used for energy. It can be reasonably assumed the oil and gas produced on the nominated lease parcels would be combusted primarily for electricity generation, transportation, industry, agriculture, commercial, and residential uses. From this assumption, the BLM provides potential GHG emissions estimates using currently available GHG emissions data. The BLM has calculated downstream/end use GHG emissions from oil and gas production data developed for each nominated lease parcel. End-use/downstream GHG emissions estimates were derived from BLM production volumes. Oil and gas production volumes were converted to metric tons of CO_2 and CH_4. A GWP factor was applied to estimated metric tons of CH_4 emissions to determine metric tons of CO_2e. GHG combustion emission factors for natural gas and petroleum were obtained from 40 CFR Part 98, Subparts A and C. The GWP used in the analysis aligns with the IPCC AR4 and EPA 40 CFR Part 98 100-year GWPs.

Estimated downstream/end use GHG emissions from future potential development of the nominated lease parcels are summarized in Table 3.23 The analysis uses the total oil and gas production values summarized in Table 2.1 (5,376,000 bbl of oil and 31,347,200 mcf of natural gas) and the EPA's GHG equivalencies calculator (EPA 2018b). As noted previously, the BLM does not direct or regulate the end use of produced oil and/or gas. The downstream/end-use GHG emissions in Table 3.23 cannot be reasonably compared to an annual metric or value because the amount of production expected from each well on an annual basis is not known; however, Table 3.24 provides historical production values at different scales of end-use. As another point of comparison, in 2014, end-use combustion emissions from fossil fuels produced on U.S. federal lands was 1,201 MMT and end-use combustion emissions of fossil fuels produced on New Mexico federal lands was 73 MMT (BLM 2019a).

Table 3.23. Estimated Production (Downstream/End-Use) GHG Emissions for the Proposed Action

Product Category	Emission Factors	Estimated Product Quantity	Estimated Emissions (MMT CO_2e of GHG)
Crude oil (bbl)	0.43 MT CO2/bbl	5,376,000	2.31
Natural gas (mcf)	0.055 MT CO2/mcf	31,347,200	1.72
Total			**4.04**

Source: EPA (2018b).

Notes: Totals may not sum exactly due to rounding. MT = metric ton.

Table 3.24. Historical Oil and Gas Production and GHG Emissions

Oil and Gas Production	2014	2015	2016	2017
U.S. oil production (Mbbl)	3,196,889	3,442,188	3,232,025	3,413,376
New Mexico oil production (Mbbl)	125,021	147,663	146,389	171,440
PDO oil production (Mbbl)	62,007	73,344	74,810	76,307
BLM Mancos-Gallup planning area oil production (Mbbl)	5,755	8,457	6,889	5,980
U.S. gas production (MMcf)	25,889,605	27,065,460	26,592,115	27,291,222
New Mexico gas production (MMcf)	1,140,626	1,151,493	1,139,826	1,196,514
PDO gas production (MMcf)	245,550	281,713	287,347	293,094
Mancos-Gallup planning area gas production (MMcf)	664,211	642,211	596,747	464,709
GHG Emissions				
Total U.S. oil and gas GHG emissions (MMT CO_2e)	2,791.29	2,961.11	2,844.84	2,961.08
Total New Mexico oil and gas GHG emissions (MMT CO_2e)	116.17	126.50	125.32	139.19
Total PDO oil and gas GHG emissions (MMT CO_2e)	40.10	46.95	47.89	48.85
Total BLM Mancos-Gallup planning area oil and gas GHG emissions (MMT CO_2e)	38.82	38.78	35.62	28.00

Source: BLM (2019a).

Note: MMcf = million cubic feet; Mbbl= thousand barrels.

3.5.2.3 *Cumulative Impacts*

CUMULATIVE GHG EMISSIONS FROM BLM NMSO LEASE SALES

The 2019 Air Resources Technical Report (incorporated by reference), Section 10.6, details recent trends of GHG emissions by sector. Within the fossil fuel combustion sector, the contribution by fuel type shows that petroleum represents 44.7% of the fuel type, natural gas 29.5%, and coal 25.8% (BLM 2019a).

In 2017, BLM commissioned a climate change report with an energy focus. The report calculates GHG emissions associated with production and consumption activities related to coal, oil, natural gas, and natural gas liquids. The baseline year is 2014 and forecasts production/consumption GHG emissions for 2020 and 2030 for federal and non-federal lands on a national level and for 13 energy-producing states, not limited to New Mexico, Oklahoma, Texas, and Kansas. Inputs for the report were developed using publicly available online information from such sources as the U.S. Energy Information Administration (EIA), EPA's *Greenhouse Gas Inventory Report: 1990–2014* (EPA 2016), U.S. Department of the Interior Office of Natural Resources Revenue, U.S. Extractive Industries Transparency Initiative, BLM oil and gas statistics, and others as applicable to each state. More information on the methodology and assumptions, as well as other data sources for all 13 states, is in the *Greenhouse Gas and Climate Change Report, 2017* (Golder Associates 2017), which is herein incorporated by reference.

In November of 2018, the USGS published a scientific investigation report, *Federal Lands Greenhouse Gas Emissions and Sequestration in the United States: Estimates 2005-2014* (Merrill et al. 2018). The 2019 Air Resources Technical Report summarizes this information and separates emissions by mineral and discloses relative percentages relative to national and worldwide GHG emissions. In 2014, end-use combustion and extraction of fossil fuels produced on New Mexico federal lands was 91.63 MMT of CO_2e. This value is comparable with the 2014 baseline reported value of 93.72 MMT of CO_2e as reported by Golder Associates (2017). The 2014 baseline for the 13 states evaluated in the Golder Associates report is 1,275.53 MMT of CO_2e, compared with an estimated 1,332 MMT CO_2e in the USGS report (Merrill et al. 2018). The values from USGS and Golder Associates include emissions from the combustion of coal, oil, and natural gas from fossil fuels produced on federal lands as well as extraction emissions from activities occurring on federal lands.

For the purposes of this analysis, BLM uses projections of the total federal and non-federal oil and gas emissions from Golder Associates (2017) to estimate expected annual future GHG emissions from energy production and consumption activity within a subnational region, including New Mexico, Oklahoma, Kansas, and Texas, which the BLM NMSO has jurisdiction over. Assumptions of the analysis are discussed in Golder Associates 2017. The following are key assumptions:

- State-specific oil consumption is equal to state total production minus export and reserves for the state based on national averages.
- National averages for sector breakdown percentages (power, industrial, etc.) for oil, natural gas, and natural gas liquids consumptions were applied to state-specific data.
- The value of production and consumption on non-federal lands is equal to the difference of the total state or nation value minus the federal lands value.

At the state level, production does not necessarily translate to 100% consumption of the fossil fuel but is representative of future energy consumption and production to show GHG emissions. The development projected in the RFDs for each BLM field office under NMSO jurisdiction (such as the 2016 RFD for the PDO; see Engler and Cather 2012, 2014) are considered in these data. Current and future lease sales are part of each RFD. Because the BLM NMSO administers lease sales within its jurisdictional area, for NEPA disclosure purposes, this section provides a discussion of reasonably foreseeable cumulative

production and consumption within these states and discloses the magnitude of GHG emissions likely to result from BLM NMSO lease sale activities on an annual basis. This information is further contextualized by comparing the relative magnitude of these emission with projected national and global annual GHG emission rates.

NEW MEXICO COAL, OIL, AND GAS GHG EMISSIONS

BLM's New Mexico reasonably foreseeable coal, oil, and gas production and consumption GHG emissions from federal activities are 95.09 MMT of CO_2e for the 2020 high scenario and 99.35 MMT of CO_2e for the 2030 high scenario (Table 3.25). These represent increases of 2.5% and 7.2%, respectively, from the 2014 baseline coal, oil, and gas GHG emissions (92.75 MMT of CO_2e). New Mexico federal coal, oil, and gas GHG emissions of 95.09 (2020 high scenario) and 99.35 (2030 high scenario) MMT CO_2e/year would represent 49% and 52% of state 2020 and 2030 high reasonably foreseeable coal, oil, and gas GHG emissions (see Table 3.25).

Table 3.25. Reasonably Foreseeable Coal, Oil and Gas Production, and GHG Consumption Emissions in New Mexico, Oklahoma, Kansas, and Texas (Golder Associates 2017)

GHG Emissions (MMT CO_2e)					
Category	**New Mexico**	**Oklahoma**	**Kansas**	**Texas**	**NM, OK, KS, TX**
2020 High Scenario					
Federal coal	13.89	1.25	0	0	15.14
Federal oil	25.49	0.33	0.08	0.06	25.95
Federal gas	49.60	0.96	0.29	2.40	53.25
Federal natural gas liquids	6.11	0.09	0.05	0.04	6.29
Total Federal	**95.09**	**2.63**	**0.42**	**2.50**	**100.64**
Federal + non-federal coal	43.12	1.87	0.13	97.46	142.58
Federal + non-federal oil	55.28	56.72	22.10	518.06	652.16
Federal + non-federal gas	83.28	152.16	18.14	694.29	947.87
Federal + non-federal natural gas liquids	12.14	20.09	3.14	84.14	119.51
Total federal and non-federal	**193.82**	**230.84**	**43.51**	**1,393.95**	**1,862.12**
2030 High Scenario					
Federal coal	10.14	0.91	0	0	11.05
Federal oil	25.60	0.33	0.08	0.06	26.07
Federal gas	57.44	1.11	0.34	2.78	61.67
Federal natural gas liquids	6.17	0.09	0.05	0.04	6.35
Total Federal	**99.35**	**2.44**	**0.47**	**2.88**	**105.14**
Federal + non-federal coal	31.52	1.37	0.1	71.12	104.11
Federal + non-federal oil	55.51	56.95	22.19	520.20	654.85
Federal + non-federal gas	96.45	176.21	21.02	804.05	1097.72
Federal + non-federal natural gas liquids	12.25	20.27	3.17	84.88	120.57
Total federal and non-federal	**195.73**	**254.8**	**46.47**	**1,480.25**	**1,977.25**

Note: Totals may not sum exactly due to rounding.

OKLAHOMA COAL, OIL, AND GAS GHG EMISSIONS

BLM's Oklahoma reasonably foreseeable coal, oil, and gas production and consumption GHG emissions from federal activities are 2.63 MMT of CO_2e for the 2020 high scenario and 2.44 MMT of CO_2e for the 2030 high scenario (see Table 3.25). This is a decrease of 1.9% and an increase of 8.9%, respectively, from the 2014 baseline coal, oil, and gas GHG emissions (2.68 MMT of CO_2e). Oklahoma federal coal, oil, and gas GHG emissions of 2.63 MMT (2020 high scenario) and 2.44 (2030 high scenario) MMT CO_2e/year would represent 1.14% and 0.96%, respectively, of state 2020 and 2030 high reasonably foreseeable GHG emissions from coal, oil, and gas activities (see Table 3.25).

KANSAS COAL, OIL, AND GAS GHG EMISSIONS

BLM's Kansas reasonably foreseeable coal, oil, and gas production and consumption GHG emissions from federal activities are 0.42 MMT CO_2e for the 2020 high scenario and 0.47 MMT CO_2e for the 2030 high scenario (see Table 3.25). These values represent increases of 5.0% and 17.5%, respectively, compared with the 2014 baseline coal, oil, and gas GHG emissions (0.40 MMT of CO_2e). Kansas federal coal, oil, and gas GHG emissions of 0.42 (2020 High scenario) and 0.47 (2030 High scenario) MMT CO_2e/year would represent 0.97% and 1.01%, respectively, of state 2020 and 2030 high reasonably foreseeable GHG emissions from coal, oil and gas activities (see Table 3.25).

TEXAS COAL, OIL, AND GAS GHG EMISSIONS

BLM's Texas reasonably foreseeable coal, oil, and gas production and consumption GHG emissions from federal activities are 2.50 MMT of CO_2e for the 2020 high scenario and 2.88 MMT of CO_2e for the 2030 high scenario (see Table 3.25). These are an increase of 4.2% and 20.7%, respectively, compared with the 2014 baseline coal, oil, and gas GHG emissions (2.40 MMT of CO_2e). Texas federal coal, oil, and gas GHG emissions of 2.50 (2020 high scenario) and 2.88 (2030 high scenario) MMT CO_2e/year would represent 0.18% and 0.19%, respectively, of state 2020 and 2030 high reasonably foreseeable GHG emissions from coal, oil, and gas activities (see Table 3.25).

Although a NEPA document may present quantified estimates of potential GHG emissions associated with reasonably foreseeable energy development, there is uncertainty with regard to eventual production volumes and variability, flaring, construction, transportation, etc. A rough estimate was possible using publicly available information and estimates from future production for RFD. Also, there is uncertainty with regard to the net effects of reasonably foreseeable energy development on climate; that is, while BLM actions may contribute to the climate change phenomenon, the specific effects of those actions on global climate are speculative given the current state of the science. Inconsistencies in the results of scientific models designed to predict climate change on regional or local scales limits the ability to quantify potential future impacts of decisions made at this level and to determine the significance of any discrete amount of GHG emissions beyond the limits of existing science.

CUMULATIVE CLIMATE CHANGE IMPACTS

Changes in climate are generally measured over long time periods to avoid the influence of meteorological or climatic cycles occurring on shorter time scales (e.g., inter-annual variability). While climate change projections are available for different regions, the climate impacts from GHGs are a global issue.

Golder Associates (2017:Section 4.0) discusses future climate projections, including four representative concentration pathways (RCPs) as identified by the IPCC: RCP 2.6, 4.5, 6.0, and 8.5. The RCP scenarios were developed based on representative GHG emission scenarios including varying assumptions regarding levels of cumulative global GHG emissions over time. RCP 8.5 assumes increasing GHG

emissions over time, with no stabilization, and is meant to be representative of scenarios leading to high GHG concentration levels. RCP 4.5 and RCP 6.0 represent scenarios where GHG emissions are reduced over time through climate policy. RCP 2.6 represents a scenario where drastic action is taken through stringent climate policy and substantial GHG emission reductions are achieved over time. The pathways are named after the radiative forcing (defined as the difference between insolation [sunlight] absorbed by the Earth and energy radiated back to space) projected to occur by 2100 (e.g., RCP 8.5 would be projected to result in 8.5 W/m^2 radiative forcing by 2100). The radiative forcing of the atmosphere in each pathway is driven by the concentration of GHGs accumulated in the atmosphere. The RCP characterizations and regions are further described by Golder Associates (2017:Section 4.1) Climate Change report.

Climate change is driven by radiative forcing, which is influenced by cumulative GHG emissions, not annual emission rates from any given sub-national project. Figure 3.1 shows a comparison of global cumulative emissions in relation to RCPs 2.6, 4.5, and 8.5, representing low, medium, and high global cumulative emissions scenarios.

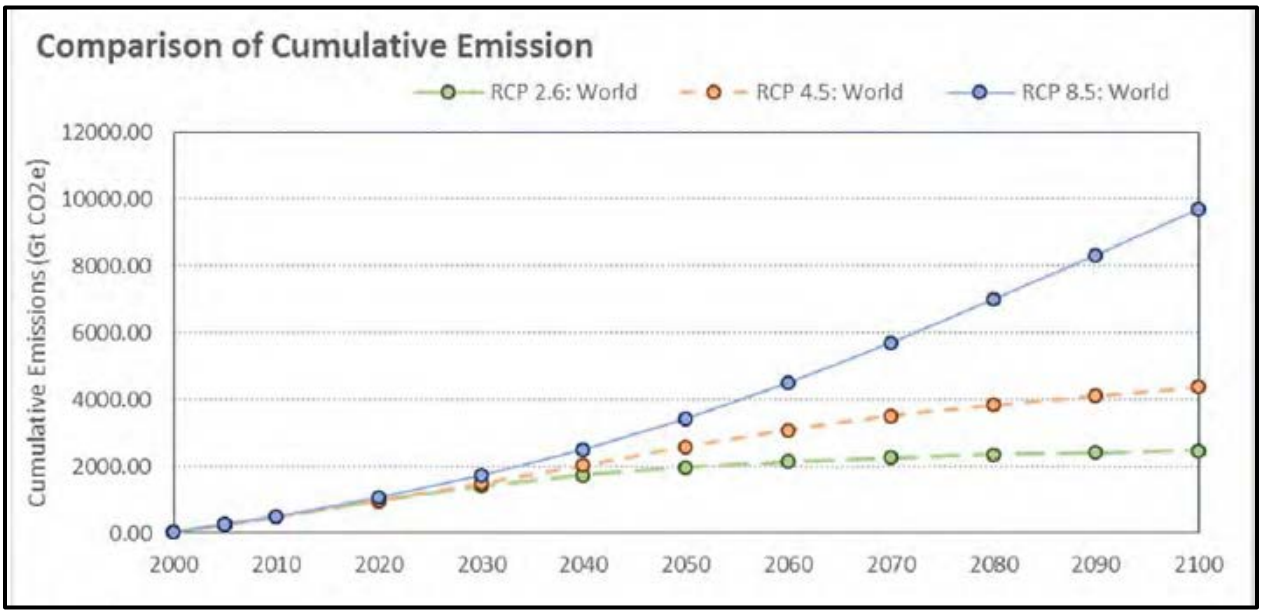

Figure 3.1. Comparison of RCP 2.6, RCP 4.5, and RCP 8.5 cumulative emission estimates over the twenty-first century.

When considering the cumulative emissions on a global scale, the annual emission rates of various sub-national projects are one of many emission contributions. Any single contribution on a sub-national scale is dwarfed by the large number of comparable national and sub-national contributors on a global scale. However, the surrogate for understanding the potential impact of BLM's sub-national scale emissions on climate is estimating projected annual emission rate due to BLM energy lease Sale Projects. Golder Associates (2017) provides projections of GHG emissions from the 13 western states that regulate most of the federal fossil fuel leasing and compares these emissions with GHG emissions from other contributors. To accomplish this comparison, the Golder Associates demonstrates a comparison of the projected BLM annual emission rates derived from federal lease sale and production information from the 13 western states and compares them against the RCP scenario emissions profile (a derived value estimating the annual GHG emission rate for each scenario). This comparison is provided in Figure 3.2. For additional context, 2014 baseline year federal resource production and consumption estimates for these 13 states can be compared with the 2014 baseline national energy consumption and total GHG emissions. BLM subnational emissions in these 13 states are approximately 25.97% of the total national energy

consumption emissions and 19.75% of national GHG emission totals at 2014 levels. In 2014, federal mineral production and consumption emissions in these 13 states represented approximately 2.64% of the global totals from all emission sources. With the relative magnitude of these emissions in mind, climate change trends and impacts are discussed below.

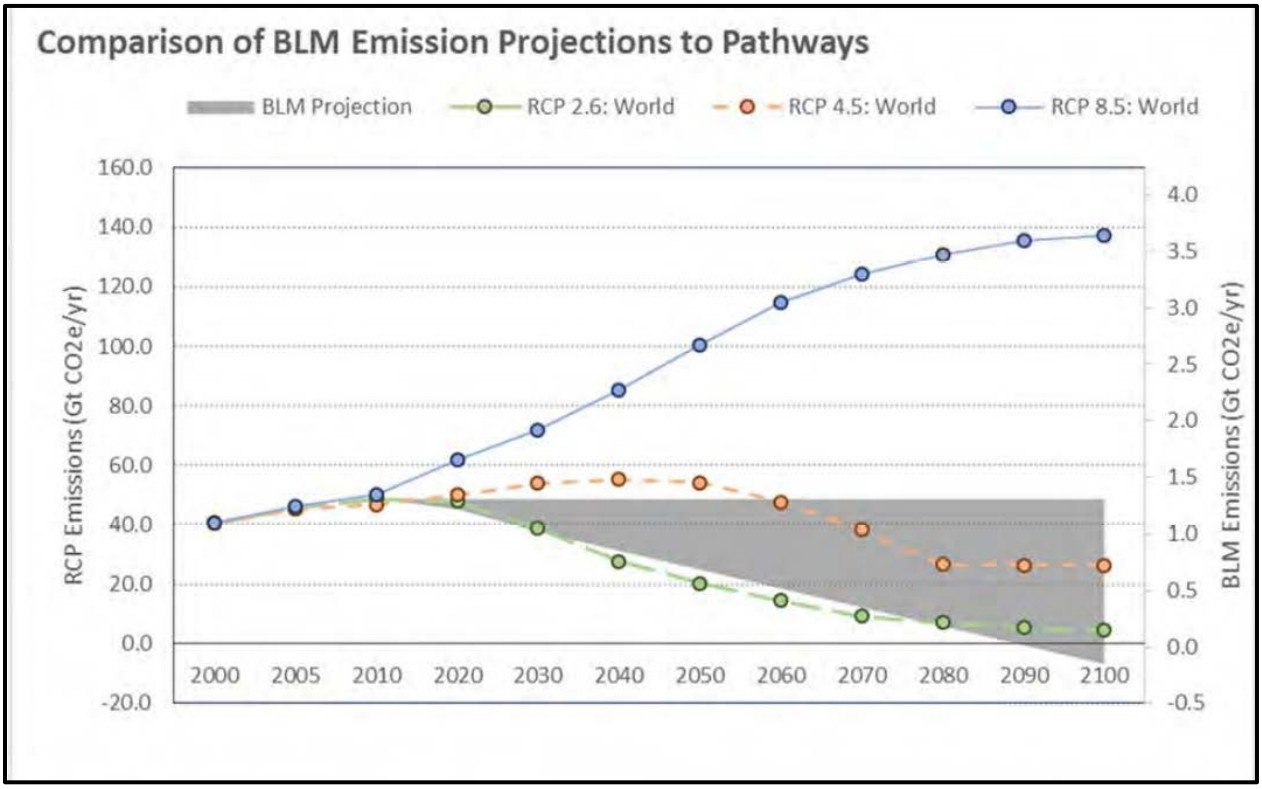

Figure 3.2. Comparison of BLM emission projections with RCP 2.6, RCP 4.5, and RCP 8.5.

The contribution of GHG emissions from coal, oil, natural gas, and liquefied natural gas for the 13 BLM subject states in 2020 and 2030 under both normal and high production scenarios were evaluated and compared with the GHG emissions profile (the derived annual emission rate for the three RCP scenarios shown in Figure 3.2). By comparing the relative emission rates of the derived ranges of BLM emissions profiles (low and high estimates) with the RCP scenarios, the BLM emissions most closely track with RCP 8.5 in 2020 and between RCP 2.6 and RCP 4.5 in 2030 (Golder Associates 2017). The reduction in BLM's emissions profile in 2030 compared with 2020 is a result of a projected change to the federal energy resource mixture. Less coal development is projected, while a slight increase in oil, gas, and natural gas liquids are projected into 2030 relative to 2020. Because coal is the most GHG-intensive fossil fuel, the reduction in this resource development is anticipated to reduce BLM's lease sale emissions profile (annual GHG emission rate) overall (see Figure 3.2).

Based on the analysis in Golder Associates (2017), BLM activities are estimated to be conducted at a level that would be in line with the level of emissions anticipated in the RCP 2.6 and RCP 4.5 through 2060. Estimates of BLM activities in future years are more uncertain and have a wider range of variability. The projections presented above are based on best available data and assumptions used to provide context to BLM's cumulative impact. However, due to the levels of uncertainty, some additional information is provided below regarding BLM's relative contribution to global emissions and, by proxy, climate change. If BLM operates under the business-as-usual scenario while all other contributors are reducing their emissions in line with RCP 2.6, the relative contribution of BLM increases as the emissions

more closely resemble RCP 4.5. If BLM operates under the decreased emissions scenario, keeping their reductions in line with RCP 2.6 like all the other contributors, the relative contribution of BLM remains similar to current contributions. If BLM operates under the decreased emissions scenario while all other contributors are maintaining constant emissions (business-as-usual) or increasing emissions, the relative contribution of BLM greatly reduces. It is very unlikely that the global cumulative emissions will be strongly influenced by a single contributor at a national or sub-national scale. However, the individual behavior of each contributor, through their relative contribution, has the ability to influence which RCP global emissions scenario is most closely resembled and, therefore, which climate change projections are most likely manifested toward the end of the century (Golder Associates 2017).

To understand the impacts of climate change, three RCP scenario projections of global temperature and precipitation changes in both the near term (representing the period from 2021 through 2040) and far term (representing the period of 2081 through 2100) are presented in Table 3.26. These estimates are derived from the average of over 30 different climate change models using the inputs of each RCP scenario.

Table 3.26. Projected Changes in Climate under Representative Concentration Pathways

RCP Pathway	Near Term		Far Term	
	Temperature (°C)	Precipitation (%)	Temperature (°C)	Precipitation (%)
RCP 2.6	0.78	1.44	0.97	2.27
RCP 4.5	0.85	1.49	1.81	3.51
RCP 8.5	0.98	1.62	3.68	5.89

Under each RCP scenario, projected average global temperatures are expected to increase and changes in precipitation are anticipated. However, generally, the impacts of climate change are least severe under the RCP 2.6 scenario and most severe under the RCP 8.5 scenario. Regardless of the specific magnitude of the impacts, the impacts to global climate are anticipated to include

- long-term global temperature change;
- intensified droughts impacting agricultural, rural, and urban communities and resulting in changes in land cover and land use;
- intensified and more frequent wildfires;
- sea level rise, ocean warming, and reduced ocean oxygen, impacting global weather patterns and flora and fauna;
- intensified flooding impacting infrastructure, natural resource–based livelihoods, and cultural resources; and
- human health, such as heat-associated deaths and illnesses, chronic diseases, and other health issues associated with poor air quality (Gonzalez et al. 2018).

To understand climate change impacts in the tri-county analysis area of the Proposed Action, impacts anticipated in the region encompassing southern Colorado and New Mexico are discussed. Climate modeling suggests that annual average temperatures in this region may rise by 4 to 6 degrees Fahrenheit by the end of the twenty-first century, with warming increasing from south to north. By 2080–2090, the southwestern United States would see a 10% to 20% decline in precipitation, primarily in winter and spring, with more precipitation falling as rain. A recent Bureau of Reclamation report (2013, as cited in BLM 2019a) made the following projections through the end of the twenty-first century for the Upper Rio

Grande Basin (southern Colorado to central-southern New Mexico) based on the current and predicted future warming:

- There would be decreases in overall water availability by one-quarter to one-third.
- The seasonality of stream and river flows would change, with summertime flows decreasing.
- Stream and river flow variability would increase. The frequency, intensity, and duration of both droughts and floods would increase (BLM 2019a).

The Bureau of Reclamation report also noted that reduction in water is expected to make environmental flows in the Upper Rio Grande system more difficult to maintain and reduce the shallow groundwater available to riparian vegetation. Both impacts have implications for the habitat of fish and wildlife in the Upper Rio Grande Basin riparian ecosystems (Bureau of Reclamation et al. 2013). A USFS assessment of 117 species of birds, reptiles, amphibians, and mammals along the Middle Rio Grande in New Mexico (Friggens et al. 2013 as cited in Bureau of Reclamation 2013) projected decreasing availability of riparian habitat, and loss of mature trees due to fire and disease that would directly and indirectly affect many species of birds and mammals. Most evaluated species were projected to experience negative effects from climate change; however, a few species that are considered generalists and highly adaptable, such as coyotes, jackrabbits, some lizards and road runners may benefit from conversion of the bosque to a more sparsely vegetated and drier habitat (Friggens et al. 2013 as cited in Bureau of Reclamation et al. 2013).

3.5.2.4 *Mitigation Measures and Residual Effects*

The BLM best management practices are designed to reduce impacts on air quality (see Issue 1) and reduce methane and GHGs. In addition, the BLM encourages industry to participate in the Natural Gas STAR program that is 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 (EPA 2006). Adoption of the Natural Gas STAR program would likely significantly reduce CO_2e emissions since the program is particularly focused on reducing methane, which has a high GWP. However, adoption of Natural Gas STAR Program best practices would reduce but not eliminate GHG emissions.

The EPA has New Source Performance Standards (codified in 40 CFR 60) in place to reduce methane emissions from oil and gas sources. NSPS OOOOa requires reduction of VOCs and methane from well completion operations from new or re-fractured hydraulically fractured wells and a requires reduction of storage tank emissions by 95% for tanks constructed after September 18, 2015, with emissions greater than 6 tons per year of VOC (this has the co-benefit of reducing methane emissions as well). NSPS OOOOa also imposes stringent semiannual leak detection and repair requirements for the collection of fugitive emission components at well sites constructed after September 18, 2015. NSPS OOOOa also requires scheduled maintenance and/or emission control devices for reciprocating and centrifugal compressor venting at compressor stations and includes provisions to limit emissions from natural gas pneumatic devices and pumps. These provisions aim to reduce fugitive emissions of methane at oil and gas facilities. The NMED and New Mexico Energy, Minerals and Natural Resources Department (EMNRD) are each in the process of developing rules that will regulate methane emissions.
The departments were charged with this task under the Executive Order on Addressing Climate Change and Energy Waste Prevention of Gov. Michelle Lujan Grisham. The order instructs NMED and EMNRD to “jointly develop a statewide, enforceable regulatory framework to secure reductions in oil and gas sector methane emissions and to prevent waste from new and existing sources and enact such rules as soon as practicable” (NMED 2019b).

3.5.3 Issue 3: Water Use and Quantity

How would future potential development of the nominated lease parcels impact surface and groundwater quantity?

The analysis area for this issue is the total area of Chaves, Eddy, and Lea Counties. Water used to support future potential development of the nominated lease parcels would likely be sourced from these counties, which collectively make up the New Mexico portion of the Permian Basin. The following analysis summarizes information contained in the *2019 BLM New Mexico Water Support Document;* hereafter referred to as the Water Support Document (BLM 2019b) and incorporated by reference. Water use for development of the nominated lease parcels is assumed to primarily come from groundwater sources based on previous oil and gas development in the area.

3.5.3.1 *Affected Environment*

CURRENT TOTAL WATER USE IN THE ANALYSIS AREA

The USGS report, *Estimated Use of Water in the United States in 2015* (Dieter et al. 2018), lists total water withdrawals across eight water use categories: aquaculture, domestic, industrial, irrigation, livestock, mining, public water supply, and thermoelectric power. Water use for 2015 is summarized in Table 3.27 for the eight water use categories in each of the three counties within the analysis area. Irrigation is the largest category of water use in all counties, accounting for an average of 75% (466,784 acre-feet [AF]) of the total water withdrawal for the analysis area (620,416 AF). Approximately 88% (546,195 AF) of the total water use is from groundwater. Mining (which includes oil and gas development) comprises approximately 15% of water withdrawals. All mining-related water use (95,800 AF) is from groundwater. Of that total, 99% of withdrawals are from saline sources.

Table 3.27. Tri-County Analysis Area 2015 Water Use by Category

Category	Surface Water			Groundwater			Total Withdrawals			
	Fresh (AF)	Saline (AF)	Total (AF)	Fresh (AF)	Saline (AF)	Total (AF)	Fresh (AF)	Saline (AF)	Total (AF)	Percent Total Use
Public Water Supply	-	-	-	39,470	-	39,470	39,470	0	39,470	6%
Industrial	-	-	-	1,121	-	1,121	1,121	0	1,121	0%
Irrigation	73,908	-	73,908	392,877	-	392,877	466,784	0	466,784	75%
Livestock	314	-	314	10,537	-	10,537	10,851	0	10,851	2%
Aquaculture	-	-	-	1,782	-	1,782	1,782	0	1,782	0%
Mining	-	-	-	1,573	94,227	95,800	1,573	94,227	95,800	15%
Thermoelectric Power	-	-	-	1,827	-	1,827	1,827	0	1,827	0%
Domestic	-	-	-	2,780	-	2,780	2,780	0	2,780	0%
Total	**74,221**	**-**	**74,221**	**451,968**	**94,227**	**546,195**	**526,195**	**94,227**	**620,416**	**100%**

Source: Dieter et al. (2018). The Mining category (highlighted in dark gray) represents the category into which the Proposed Action falls.

Note: See the Water Support Document (BLM 2019b) for graphical representation of these data, as well as comparisons with water use across the state of New Mexico.

CURRENT WATER USE ASSOCIATED WITH OIL AND GAS DEVELOPMENT

As part of oil and gas development, water is used for drilling fluid preparation and make-up water for completion fluids, in well stimulation (of which the most common method is hydraulic fracturing), as rig wash water, as coolant for internal combustion engines, for dust suppression on roads or well pads, and for equipment testing. Water uses for oil and gas development in the Pecos District tri-county area are typically sourced from groundwater. Of these uses, hydraulic fracturing activities comprise the vast majority of water use. The amount of water used for hydraulic fracturing is dependent on many factors, including the geologic formation. In the PDO, most wells use water for completion, rather than nitrogen gel or slickwater completion technologies (BLM 2020d).

Oil and gas operators are required by the State of New Mexico to disclose water use to FracFocus (per NMAC 19.15.16), a national hydraulic fracturing chemical registry managed by the Ground Water Protection Council and Interstate Oil and Gas Compact Commission to provide objective information on hydraulic fracturing. The BLM examined FracFocus data reported for the calendar years of 2014 to 2018 (FracFocus 2019) to ascertain actual water use in the analysis area (Table 3.28).

Table 3.28. Actual Water Use in the Tri-County Analysis Area for Calendar Years 2014 to 2018

Year	Federal Water Use (AF)	Non-Federal Water Use (AF)	Total Water Use (AF)	Federal Water Use (%)	Average Water Use per Well (AF)	Total Number of Wells Reported to Frac Focus
2014	1,307	2,509	3,816	34%	6.82	559
2015	4,033	4,336	8,369	48%	15.82	529
2016	710	6,091	6,801	10%	21.66	314
2017	2,964	11,418	14,382	21%	26.44	544
2018	8,411	19,681	28,092	30%	31.04	905
Total	**17,425**	**44,035**	**61,460**	**–**	**–**	**2,851**

Source: FracFocus (2019). The analysis contained in this table provides percentage contribution rounded to two decimal points.
Note: Tri-county analysis area is Lea, Chaves, and Eddy Counties.

Water use has increased from 3,816 AF in 2014 to 28,092 AF in 2018, with a corresponding basin-wide average water use per well increase from 6.82 AF per well to 31.04 AF per well (FracFocus 2019). This is due to the higher volume of wells, the likelihood that horizontal wells are being drilled to longer lengths, and the continued use of hydraulic fracturing technologies in well drilling and completion.

3.5.3.2 *Environmental Impacts*

Drilling and completion of 32 horizontal wells on the nominated lease parcels are estimated to use approximately 998 AF of groundwater. This calculation is based on a factor of 31.2 AF per horizontal well, which the BLM considers to be the most accurate current estimate of water use associated with drilling and completion of a single horizontal well within the analysis area (BLM 2019b). If more water-intensive stimulation methods (e.g., slick water fracturing) are implemented or if laterals become longer, water use could increase from estimates provided in the Water Support Document (BLM 2019b). Alternatively, water use estimates could be lower if produced water is reused or recycled, or if less water-intensive stimulation methods are used (e.g., nitrogen) in hydraulic fracturing.

If all wells were developed in a single year (an unlikely scenario), groundwater water use associated with future potential development of the leases would result in a 0.16% increase of the Pecos District tri-county area total water use (620,416 AF), 0.18% of the Pecos District tri-county area total groundwater

use (546,195 AF), and would result in an 1.04% increase over 2015 water use in the mining category for the Pecos District tri-county area (95,800 AF). The total estimated water use for drilling and completion of the 32 horizontal wells in the nominated lease parcels (998 AF) in a single year represents approximately 3.55% of the 2018 oil and gas water use reported to FracFocus (28,092 AF).

Assuming a 20-year development scenario (consistent with the RFD time frame), the water use associated with development of the lease parcels would be approximately 50 AF for any given year. Projected future potential development of the leases would result in a 0.01% increase of the Pecos District analysis area total water use (620,416 AF), 0.01% of the Pecos District analysis area total groundwater use (546,195 AF), and would result in a 0.05% increase over 2015 water use in the mining category for the Pecos District analysis area (95,800 AF). The total estimated water use of 50 AF in a single year represents approximately 0.18% of the 2018 oil and gas water use reported to FracFocus (28,092 AF).

Water used for the purpose of oil and gas drilling and completion would be purchased legally from those who hold water rights in or around the Permian Basin. The transaction would be handled by the New Mexico Oil Conservation Division, as well as the New Mexico Office of the State Engineer. All water uses would be evaluated at the time of proposed lease development in site-specific NEPA analysis and subject to standard lease terms and conditions. Table 2-9 of the Water Support Document (BLM 2019b) identifies the potential sources of groundwater in the analysis area.

Produced water associated with development of the lease parcels is estimated at approximately 18,604,800 bbl of water. Produced water would be disposed of at regulated and permitted commercial facilities (such as saltwater disposal wells) or would be used in the drilling and completion of wells. Water sourced from outside of the geological formation that is used in hydraulic fracturing, which remains in the geological formation after hydraulic fracturing is complete, is likely lost to the hydrological water cycle (Kondash et al. 2018).

3.5.3.3 *Cumulative Impacts*

Past and Present Actions—Past and present use is discussed in Section 3.5.4.1, Affected Environment. As noted in this section, Pecos District tri-county area total water usage is 620,416 AF; mining (which includes oil and gas development) comprises approximately 15% of tri-county water withdrawals. In 2018, the statewide oil and gas water use reported to FracFocus was 28,092 AF (BLM 2019b). The largest water use category within the analysis area and within the state of New Mexico is irrigation, comprising 75% of all water use within the Pecos District tri-county area and 82% of all water use within the state.

Reasonably Foreseeable Future Actions—Between 2012 and 2014, the BLM developed an RFD scenario for the PDO that projected approximately 800 new wells per year, for a total of 16,000 wells over a 20-year period. With consideration of the revised water use estimates discussed in the Water Support Document (31.2 AF per well), development of the RFD scenario would require 499,200 AF water, or 24,960 AF of water in any given year if all wells were drilled horizontally (BLM 2019b). Note that this includes both federal and non-federal wells. This is about 4% of Pecos District tri-county area 2015 total water withdrawals (620,416 AF, which already includes past and present water use). Irrigation would remain by far the largest water use within the analysis area (currently 75% of all water use within the Pecos District tri-county area and 82% of all water use within the state). Well development projected as a result of ongoing BLM and state lease sales is included in this RFD scenario. Well development associated with recent or reasonably foreseeable APDs or master development plans is also included in the RFD scenario.

There are no reasonably foreseeable mining projects that would contribute to cumulative water withdrawals within the tri-county analysis area. Some water use would be required during construction

and operation of reasonably foreseeable transmission lines and pipelines; these uses are addressed in the Water Support Document (BLM 2019b).

As noted in Section 3.5.2.1, predicted impacts from climate change for the analysis area include intensified droughts. A recent Bureau of Reclamation report (2013, as cited in BLM 2019a) predicts decreases in overall water availability by one-quarter to one-third through the end of the twenty-first century for the Upper Rio Grande Basin (southern Colorado to central southern New Mexico).

Cumulative Water Use—Development of the RFD scenario, which comprises all RFFAs, would require 499,200 AF water, or 24,960 AF of water in any given year if all wells were drilled horizontally. Annual water use associated with future potential development of the proposed lease parcels (32 wells, resulting in 998 AF of water, or 50 AF of water in any given year) would comprise 0.2% of the cumulative impact. If more water intensive stimulation methods (e.g., slick water fracturing) are implemented or if laterals become longer, cumulative water use could increase from estimates provided in the Water Support Document (BLM 2019b). Alternatively, water use estimates could be lower if produced water is reused or recycled for use in hydraulic fracturing or if methods such as nitrogen completions are implemented.

3.5.3.4 *Mitigation Measures and Residual Effects*

Public concern about water use from hydraulic fracturing is especially high in semiarid regions such as the tri-county analysis area, where water withdrawals associated with hydraulic fracturing comprise the majority of oil and gas–related water use.

Overall, there have been calls to increase the use of alternative water sources such as brackish water or recycling produced water, minimizing the extent to which oil and gas–related consumptive water uses contribute to the strain on local freshwater resources (Kondash et al. 2018). The BLM encourages the use of recycled water in hydraulic fracturing techniques, and in 2019, the State of New Mexico passed the Produced Water Act, which encourages oil and gas producers to reuse produced water when possible, rather than relying on freshwater sources for oil and gas extraction.

Recent studies indicate that the water used for hydraulic fracturing may be retained within the shale formation, with only a small fraction of the fresh water injected into the ground returning as flowback water; water returning to the surface is highly saline, is difficult to treat, and is often disposed through deep-injection wells (Kondash et al. 2018). NMED recently signed a memorandum of understanding with New Mexico State University to develop new technologies for treating produced water to inform future policies for produced water reuse.

3.5.4 Issue 4: Dunes Sagebrush Lizard and Lesser Prairie-Chicken

How would future potential development of the nominated lease parcels impact dunes sagebrush lizard (DSL) and lesser prairie-chicken (LPC)?

The analysis area established to analyze impacts on LPC and DSL is Chaves, Eddy, Lea, and Roosevelt Counties which encompasses the PDO, in which habitat for these species is located.

3.5.4.1 *Affected Environment*

Species proposed for listing under the Endangered Species Act (ESA) as threatened or endangered are managed with the same level of protection as listed species. BLM policy for candidate species is contained in BLM Manual 6840 (BLM 2008c). The BLM carries out management consistent with the principles of multiple use for the conservation of special status species and candidate species and their habitat. The BLM must ensure that actions authorized, funded, or carried out do not contribute to the need to list any of these

species as threatened or endangered, and that BLM actions would not adversely affect the likelihood of recovery of any threatened or endangered species (BLM 2008c). Under the ESA, DSL was petitioned for listing in 2018, and LPC was petitioned for relisting in 2016. Both DSL and LPC petitioned listings are under review under the ESA.

DUNES SAGEBRUSH LIZARD

The DSL is a habitat specialist native to the shinnery oak sand dune habitats extending from the San Juan Mesa in northeastern Chaves County, Roosevelt County, and through eastern Eddy and southern Lea Counties. Approximately 65% to 75% of DSL habitat range occurs within New Mexico, with the majority of this portion occurring within the planning area (Smolensky and Fitzgerald 2011; USFWS 2020d). This species has an extremely strong affinity for bowl-shaped depressions in active dune complexes referred to as sand dune blowouts, with a preference for relatively large blowouts and select microhabitat within a given blowout (BLM 2007, 2008a). Within their geographic range, the presence of this species is also associated with composition of the sand; they only occur at sites with relatively coarse sand.

Currently, the species is listed as sensitive by the BLM New Mexico State Office (NMSO) and endangered by the State of New Mexico. This species was petitioned for federal listing in 2018 and is under review under the ESA. This species' current management within the State of New Mexico is currently being driven by the state listing status and protections afforded under the CCA (USFWS, BLM, and Center of Excellence for Hazardous Materials Management [CEHMM] 2008) and Candidate Conservation Agreement with Assurances (CCAA) prescriptions (USFWS and Western Association of Fish and Wildlife Agencies [WAFWA]/Foundation for Western Fish and Wildlife [FWFW] 2014; USFWS and Texas Comptroller of Public Accounts [CPA] 2019), as well as the Special Status Species Resource Management Plan Amendment (RMPA) of 2008 (BLM 2008a). The CCA and CCAA are voluntary agreements limited to existing participants.

There is a total of 543,527 acres of DSL-mapped occupied and suitable habitat within the PDO region (Laurencio and Fitzgerald 2010). The portion of DSL habitat within the PDO planning area is a spatially dynamic system of patches of shinnery oak and sand dune complexes with interspersed flat areas without dunes. The connectivity of dune complexes and the ability of DSLs to locally migrate between occupied dunes is essential to reproductive success (Smolensky and Fitzgerald 2011). The utilization of microhabitats within a greater system, in conjunction with the species' small size and restricted ability to travel long distances, places this species at risk of adverse impacts from surface occupancy development directly destroying dunal habitat or indirectly fragmentating habitat (Smolensky and Fitzgerald 2011). Separation of dunal complexes restricts movement of populations and reduces genetic transfer and the likelihood of population recovery through successful reproduction (Smolensky and Fitzgerald 2011).

Due to specialized habitat requirements, DSL are particularly sensitive to anthropomorphic development, including oil and gas development. With the historical and current development of the Permian Basin, DSL have experienced an increase in habitat fragmentation and decrease in available suitable habitat within the PDO, which can be attributed in part to previous oil and gas disturbance. A study of eight species of lizard that utilize dunal habitat (within the PDO DSL Texas A&M University [TAMU] habitat polygon) found that DSL utilization of fragmentated habitat decreases when well pads reach a threshold of 13 per section, compared to normal utilization when fragmentation is below three well pads per section (Leavitt and Fitzgerald 2013). This species is most sensitive to permanent surface disturbances which prevent movement between suitable habitat dispersed within complexes.

LESSER PRAIRIE-CHICKEN

LPC was proposed for listing as threatened in December 2012 (*Federal Register* 77:73828–73888), and the USFWS announced the final listing of the species as threatened under the ESA in April 2014 (*Federal*

Register 79:19974–20071). In July 2016, the LPC was removed from the Federal List of Endangered Species and Threatened Wildlife (*Federal Register* 81:47047–47048). The listing decision was vacated by the U.S. District Court for the Western District of Texas on September 1, 2015, and was not due to the successful recovery of populations and/or habitat. The LPC was then petitioned for relisting to the Federal List of Endangered Species and Threatened Wildlife in November 2016 (*Federal Register* 81:86315–86318). The relisting of this species is still under review. Consequently, the BLM CFO management of the LPC is determined by the 2008 Special Status Species RMPA (BLM 2008a). In addition, in the state of New Mexico, management is currently being driven by listing status and protections afforded under the LPC/DSL CCA (USFWS, BLM, and CEHMM 2008) and CCAA prescriptions (USFWS and WAFWA/FWFW 2014; USFWS and Texas CPA 2019). The CCA and CCAA are voluntary agreements limited to existing participants.

In New Mexico, the LPC formerly occupied a range that encompassed the easternmost third of the state, extending from the Pecos River to 30 miles west near Fort Sumner. This occupied area covered about 14,672 square miles in nine eastern counties: Union, Harding, Chaves, De Baca, Quay, Curry, Roosevelt, Lea, and Eddy, at the beginning of the twentieth century. Remnant populations are known to exist only in parts of Lea, Eddy, Chaves, and Roosevelt Counties. The currently occupied area comprises approximately 20% of the species' historical range.

LPC are found throughout dry grasslands that contain shinnery oak (*Quercus havardii*) or sand sagebrush (*Artemisia filifolia*). Currently, they are most commonly found in mixed-grass vegetation, sometimes in short-grass prairie habitat. They are occasionally found in farmland and smaller fields, especially in winter. Shinnery oak shoots are used as cover and produce acorns, which are an important food source for the species. The current geographic range of shinnery oak is nearly congruent with that of the LPC, and these species sometimes are considered ecological partners. Population densities of LPC are greater in shinnery oak habitat than in sand sagebrush habitat (BLM 2007, 2008a).

LPC use a breeding system in which males form display groups on arenas called leks. During mating displays, male vocalizations, called booming, attract females to the lek. Leks are often on knolls, ridges, or other raised areas; however, leks are just as likely to be on flat areas in New Mexico due to topography constraints. Leks may be completely bare, covered with short grass, or have scattered clumps of grass or short tufts of plants. The visibility of surroundings and the ability of the females to hear the male vocalizations are important characteristics of occupied leks. Due to their breeding system and obligate vegetation requirements, LPC are particularly sensitive to anthropomorphic development (including oil and gas development) and habitat fragmentation. Lek use and nesting activity in Eddy and Lea Counties substantially decreased (and in many areas ceased to exist) during increased oil and gas development periods accompanied by severe droughts, impacting the same LPC habitat components. A number of active leks (33) were documented well into the 1990s by BLM biologists, who conducted the primary lek surveys during that era within both the BLM CFO (Eddy and Lea Counties) and BLM Roswell Field Office (Chaves and Roosevelt Counties) (Sherman 2020). There are currently no known active leks within the BLM CFO. Within the BLM Roswell Field Office planning area, where there is a greater density of LPC, there were 297 known active leks, 179 of which were surveyed for LPC in 2019 (Baggao 2020). Of the 179 leks surveyed, 57 were found to be active (Baggao 2020). Adult LPC are known to stay within approximately 3 km (1.9 miles) of their lek and nesting site, with the exception of juveniles traveling upwards of 12 km (7.5 miles) once fledged to establish territory (Hunt 2004).

As a species that inhabits expansive grasslands lacking in tall canopy vegetation, the species has been theorized to be inherently fearful of anthropomorphic aboveground structures. Linear infrastructure such as roads and overhead transmission lines, as well as noise produced by oil and gas infrastructure, have been determined to be the more impactful disturbance types for LPC; however, impacts of overgrazing within suitable grassland habitat has also been determined to contribute to the decrease in New Mexico populations (Hunt 2004). Analysis of LPC tolerance for development disturbance within their habitat has

shown that the species is susceptible to noise, activity, and visual alterations within their habitat (Hunt 2004; Pruett et al. 2009; Thompson et al. 2015). Research has determined that this species has an avoidance buffer of at least 100 m (328 feet) from linear infrastructure disturbance such as transmission power lines and roads (Pruett et al. 2009). It was found that LPC also avoid crossing roads and have a strong avoidance of overhead power lines. The primary predators of LPC are avian raptor species which perch on tall objects (natural and industrial alike) to survey for prey, thus increased tall structure density within habitat may increase predation pressure and avoidance of these areas by existing populations (Pruett et al. 2009; Thompson et al. 2015).

In addition to the general avoidance of aboveground disturbance by 100 m, development and infrastructure of habitat has been found to impact LPC habitat utilization for breeding purposes. In a 10-year radio collar study of 463 LPC, it was found that the closest an attempted nest was to energy infrastructure disturbance was 201 m (659 feet), with 85% of recorded nests being at least 2 km from the nearest power line or road (Pruett et al. 2009). Also analyzed in the study was lek utilization, of which two of 26 recorded active LPC leks were within 2 km of linear infrastructure disturbance, with the closest being 1,003 m (3,290 feet) away from the line (Pruett et al. 2009). A 2016 study on LPC in the Mixed-Grass Prairie Ecoregion of Oklahoma, Kansas, and Texas found that habitat use for nesting and brood-rearing is estimated to be affected up to 1 mile from anthropogenic structures (Wolfe et al. 2016). Additionally, a 2011 study on prairie grouse (a species related to the LPC) found a general effect for displacement and reduced demographic rates for prairie grouse due to oil and gas development (Hagen 2010).

The analysis area contains five designations of LPC management areas totaling 1,499,746 acres: the Core Management Area (CMA, totaling 221,402 acres), the Primary Population Area (PPA, totaling 265,730 acres), the Sparse and Scattered Population Area (SSPA, totaling 218,126 acres and found only in the Roswell Field Office), and the Isolated Population Area (IPA, totaling 794,487 acres, and which include 17 Habitat Areas [HAs]; totaling 112,989 acres). As stated in the 2008 Special Status Species RMPA (BLM 2008a), the following management prescriptions apply:

- Within the PPA, areas designated as occupied or suitable LPC habitat are generally closed to new leasing; any new leasing allowed would have NSO stipulations (BLM 2008a).
- Within the SSPA, occupied LPC habitat (within 1.5 miles of the lek) is generally closed to new leasing. New leasing with an NSO requirement may be allowed, where this is determined to be appropriate, i.e., pooling or drainage protection that does not impact suitable habitat (BLM 2008a). This area is specific to the Roswell Field Office and is not found within the CFO.
- Within the IPA, occupied LPC habitat (e.g., within 1.5 miles from an active lek) is also generally closed to new leasing; new leasing with an NSO requirement may be allowed, where this is determined to be appropriate (BLM 2008a).

In the future, new leasing in occupied LPC habitat would be linked to the status of the species or habitat in New Mexico, as identified in the annual USFWS candidate notice of review or other periodic agency review. If new leasing is considered, conditions will be attached that would preclude listing the special status species as threatened or endangered (BLM 2008a).

Habitat fragmentation analysis currently being conducted in support of the ongoing BLM CFO RMP revision has shown that there are no existing surface-disturbing activities within the LPC PPAs on BLM-managed surface lands and non-BLM managed surface lands; therefore, this area is not fragmented and provides the species the best area for habitat and reproductive opportunities (BLM 2008a, n.d.-b). Within the LPC IPA, a large portion of the habitat has already been fragmented beyond the species-specific thresholds for non-breeding purposes, and almost all of the habitat has been fragmented beyond the species-specific threshold for breeding purposes on both BLM-administered lands and non-BLM lands

(BLM 2008a, n.d.-b). Within the LPC HAs, most of the habitat is considered suitable for this species for non-breeding purposes on both BLM-managed surface lands and non-BLM managed surface lands; however, most of the LPC HA is not considered suitable for this species for breeding purposes on BLM-administered lands and non-BLM lands (BLM 2008a, n.d.-b). Overall, the LPC HA is less fragmented from oil and gas development on BLM-administered lands than non-BLM lands, which can likely be attributed to the mitigation measures outlined in the 2008 Special Status Species RMPA that establishes protections for this species (BLM 2008a, n.d.-b).

3.5.4.2 *Environmental Impacts*

Surface disturbance from future potential development of the nominated lease parcels would likely result in a decrease of habitat quality from human presence and loss of suitable habitat for DSL and LPC. Oil and gas–related traffic may result in direct mortalities. Following reclamation, these effects are expected to decrease over time; however, the degree and speed of recovery is anticipated to vary depending on site-specific ecological conditions and environmental factors.

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Using the DSL TAMU polygon, which is a model based on known occupied DSL habitat (Laurencio and Fitzgerald 2010), nominated lease parcels 361, 368, 369, 370, 382, 384, 390, and 6741 are within DSL known occupied habitat. Table 3.29 presents acreage and percentage of parcels within known occupied habitat as well as applicable stipulations and lease notices. CFO biologists also reviewed aerial imagery and identified suitable DSL dunal habitat within nominated lease parcels 366, which lies outside of known occupied habitat.

Table 3.29. DSL Known Occupied and Suitable Habitat and Stipulations by Parcel

Habitat Type (acres)	Lease Parcels (acreage)	Total Parcel Acreage within Habitat Type (acres)	Total Parcel Acreage within Habitat Type (percent)	Total Surface Disturbance within Parcels (acres)	Total Surface Disturbance within Habitat Type (percent)	Applicable Stipulations and Lease Notices†
Known Occupied Habitat* (543,527)	361 (80), 368 (40), 369 (40), 370 (160), 382 (42.3), 384 (240), 390 (40), 6741 (320)	533.84	55.48%	36	0.00007%	SENM-S-23-CSU; SENM-LN-2: parcels 361, 368, 369, 382, 384, 390, 6741†. SENM-S-54-NSO: parcels 370‡ and 6741‡. SENM-S-34-CSU: parcel 384:
Total	**962.3**	**533.84**	**55.48%**	**36**	**0.00007%**	

Note: DSL is not listed under the ESA. However, if this species is listed in the future, stipulation WSO-ESA-7 would offer protections for this species for all parcels listed in this table.

* Known occupied habitat is according to the DSL TAMU polygon model (Laurencio and Fitzgerald 2010).

† Stipulation SENM-S-23-CSU and lease notice SENM-LN-2 is only applied to T. 17 S., R. 31 E. NMPM Sec. 27 N2SE, NESW of parcel 6741.

‡ Stipulation SENM-S-54-NSO is applied entirely to parcel 370 and to T. 17 S., R. 31 E., NMPM, Sec. 27 S2SE, NWSW, S2SW of parcel 6741.

The nominated lease parcels located within the DSL known occupied habitat and biologist-identified suitable habitat within parcel 366 would be subject to stipulation SENM-S-23-CSU, which would not allow development in documented occupied habitat areas or within up to 200 m of suitable habitat associated with occupied habitat areas. Lease notice SENM-LN-2 would require pre-disturbance presence/absence biological surveys within these parcels (see Appendix C for full descriptions of stipulations). Additionally, stipulation SENM-S-54-NSO is applied entirely to nominated lease parcel 370

and to portions of nominated lease parcel 6741 (see Appendices A and C) for LPC habitat, that may provide protection to DSL if DSL are found to be present during site specific surveys. Additionally, stipulation SENM-S-34-CSU is applied to nominated lease parcel 384 which requires submittal of a POD for the entire lease for review and approval, including NEPA analysis, by the BLM, prior to approval of development actions.

The stipulations would reduce or eliminate surface disturbance in and near occupied habitat within the nominated lease parcels; however, roads and other linear features associated with development of the lease parcel may contribute to habitat fragmentation by inhibiting DSL from colonizing other suitable habitat or by reducing the overall fitness of the species by isolating populations from one another. This can lead to less resilience to stochastic events and lead to genetic bottlenecks. Some linear disturbance when reclaimed can create suitable dune habitat if sand deposits become established. The lease notice listed in Table 3.29 notifies the operator that the lease may include suitable and/or occupied DSL habitat, may require species specific surveys, and lease development activities may be limited to areas outside of suitable or occupied habitat within the lease. In conjunction with lease notices and stipulations applied to the nominated lease parcels, site-specific analysis and pre-disturbance biological surveys at the lease development stage would contribute to avoidance, minimization, and reduction of impacts to known occupied habitat and habitat fragmentation.

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Approximately 1,039.27 acres of 12 of the nominated lease parcels are located within the 794,487-acre LPC IPA (Table 3.30). Approximately 363.16 acres of two of the nominated lease parcels are located within an 112,989-acre LPC IPA-HA (see Table 3.30). The LPC IPA-HA is subject to no surface occupancy and would require off-lease development. Depending on the selected location of surface disturbance, development of these nominated lease parcels could result in up to 58.5 acres of surface disturbance within the LPC IPA, and a potential decrease in LPC habitat quality from human presence and loss of vegetation (see Table 3.30). One lek is present within nominated lease parcel 369, and it is unknown if it is an active lek. There are no other leks found within or within 2-miles of the nominated lease parcels. Colocation of development with existing disturbance during site selection has the opportunity to decrease direct and indirect impacts on this species.

Table 3.30. Potential Impacts to LPC Management Areas from Future Potential Development of the Nominated Lease Parcels

LPC Management Areas (acres)	Lease Parcel (acres)	Description of Overlap	Total Surface Disturbance (acres)	Applicable Stipulations and Lease Notices
IPA - HA (112,989)	370 (160) 6741 (320)	Parcel 370 is 99.82% within the LPC IPA-HA. Parcel 6741 is 63.57% within the LPC IPA-HA. Total acres of overlap of the nominated lease parcels within the LPC IPA-HA is 363.16 acres (0.003% of the LPC IPA-HA.	0	SENM-S-54-NSO: parcels 370‡ and 6741‡ Timing Restriction Zone-COA

LPC Management Areas (acres)	Lease Parcel (acres)	Description of Overlap	Total Surface Disturbance (acres)	Applicable Stipulations and Lease Notices
IPA (794,487)	361 (80) 363 (120) 366 (80) 368 (40) 369 (40) 370 (160) 371 (80) 382 (42.3) 383 (80) 384 (240) 390 (40) 6738 (80) 6741 (320)	Parcels 361, 363, 366, 368, 369, 370, 371, 382, 383, 384, and 390 are 100% within the LPC IPA. Parcel 6738 is 99.37% within the LPC IPA. Parcel 6741 is 36.48% within the LPC IPA. Parcel 370 is 0.22% within the LPC IPA. Total acres of overlap of the nominated lease parcels with the LPC IPA is 1,039.27 acres (0.13% of the LPC IPA).	58.5 acres (0.00007% of the LPC IPA)	SENM-S-22-CSU: parcels 361, 363, 366, 368, 369, 371, 382, 383, 384, 390, 6738 SENM-S-34-CSU: parcel 384 SENM-S-54-NSO: parcels 370‡ and 6741‡ Timing Restriction Zone-COA

Note: IPA = Isolated Population Area; IPA-HA = Isolated Population Area - Habitat Area. See Section 3.5.4.1 for descriptions.

‡ Stipulation SENM-S-54-NSO is applied entirely to parcel 370 and to T. 17 S., R. 31 E., NMPM, Sec. 27 S2SE, NWSW, S2SW of parcel 6741.

Stipulation SENM-S-54-NSO, which prohibits surface disturbance, is applied to parcels within the IPA-HA, and stipulation SENM-S-22, which prohibits drilling within up to 200 m of leks, and places timing and noise restrictions on surface use, is applied to parcels within the IPA that do not have the NSO stipulation applied (see Table 3.30). Impacts to the lek located within parcel 369 could be avoided, given protections from the applied stipulation. Therefore, the current LPC breeding effort is expected not to be impacted. All parcels within the IPA-HA and IPA would also be subject to LPC Timing Restriction Zone COAs to restrict the timing of construction activities to reduce potential noise impacts from during LPC breeding season. Additionally, stipulation SENM-S-34-CSU, which provides protections to shinnery oak sand dune habitat, through a POD requirement is also applied to parcel 384. Stipulations for DSL (see Table 3.29) applied to nominated lease parcels 361, 368, 369, 382, 384, 390, and 6741 may also provide protections to LPC where habitat areas overlap.

Together, the lease notices, CSU, and NSO stipulations applied to the nominated lease parcels would minimize impacts to LPC and LPC habitat within the nominated lease parcels listed in Table 3.30. Site-specific analysis and pre-disturbance biological surveys at the lease development stage would contribute to avoidance, minimization, and reduction of impacts to suitable habitat.

3.5.4.3 *Cumulative Impacts*

As with impacts on wildlife, past and present actions that affect and have affected special-status wildlife include land use authorizations, livestock grazing, recreational uses (including off-highway vehicles, non-motorized recreation, etc.), mineral exploration and development, fire and fuels treatments, and other vegetation treatments, including noxious weeds management. As identified in Section 3.3, there are an estimated 317,000 acres of past and present surface-disturbing activities within the cumulative analysis area, which includes activities such as construction of gas plants, potash mines, oil and gas well pads (for an estimated 41,006 wells), access roads, transmission lines, and other linear features. Although some species are afforded species-specific protections (e.g., LPC and DSL) by BLM requirements for avoidance or minimization, including conservation agreements, as well as the implementation of USFWS and NMDGF protection measures to protect or mitigate for impacts to species habitat, the intensive development has reduced areas that could have potentially been used to expand species populations.

The RFD scenario includes oil and gas development as well as other mining and land development RFFAs (approximately 72,000 acres of surface disturbance). The 2012 and 2014 RFD scenario projects that 800 new 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). Roads and pads associated with oil and gas development contribute to habitat fragmentation and may inhibit special status species from colonizing other suitable habitat. Oil- and gas-related traffic may result in direct mortalities. Habitat fragmentation can reduce the overall fitness of a species by isolating populations from one another, making it more difficult for populations to migrate between one another. This can lead to less resilience to stochastic events and lead to genetic bottlenecks.

For DSL, the development of the RFD scenario would result in increased habitat fragmentation beyond existing habitat fragmentation levels. This increase would likely create an even greater barrier in the habitat corridor between northern and southern suitable dune complexes within New Mexico. Further development and surface occupancy have the potential to increase impacts to dunal habitat and increase fragmentation. Increased fragmentation further decreases the likelihood of utilization of habitat by this species and other reptile species with similar habitat specialization within this area. Future potential development associated with the Proposed Action (an estimated 32 wells or one well per parcel) is approximately 0.002% of the RFD (16,000 wells) while contributing to continued habitat fragmentation.

For LPC, habitat fragmentation and increased density of development from the RFD scenario risks reducing habitat viability further past above described thresholds. Increased fragmentation from development of the RFD scenario is expected within the LPC SSPA and IPA, which would further degrade the amount of available habitat and decrease habitat quality in this area from human presence and loss of vegetation. Modeling conducted in support of the ongoing RMP effort for the BLM CFO has determined that the IPA is already (99%) unsuitable for reproductive efforts for this species according to these species-specific thresholds (BLM 2008a, n.d.-b); any further fragmentation would decrease the effectiveness of reclamation activities in this area. BLM efforts to close the IPA-HA and PPA from further surface occupancy from energy development would protect currently used habitat and allow for reclamation efforts to increase the availability of non-fragmented, suitable LPC habitat in these areas. Anticipated surface disturbance from future potential development of the nominated lease parcels would impact approximately 58.5 acres (0.00007%) of the LPA IPA (794,487 acres), and 9 acres (0.00008%) of the LPC IPA-HA (112,989 acres), and would not result in any future potential development within the CMA, PPA, or the SSPA.

3.5.4.4 *Mitigation Measures and Residual Effects*

Under the authority granted in standard terms and conditions attached to each lease, measures to reduce impacts on or avoid resource values, land uses, or users would be attached as COAs to the APD. Under 43 CFR 3101-1-2, such reasonable measures may include, but are not limited to, modification to siting or design of facilities, timing of operations, and specification of interim and final reclamation measures. At a minimum, measures shall be deemed consistent with lease rights granted provided that they do not require relocation of proposed operations by more than 200 m; require that operations be sited off the leasehold; or prohibit new surface-disturbing operations for a period in excess of 60 days in any lease year. Potential mitigation would reduce the risk of impacts on species; however, residual impacts may still include habitat fragmentation especially from roads and associated infrastructure outside of key habitat areas avoided through lease stipulations.

CHAPTER 4. CONSULTATION AND COORDINATION

The following consultation and coordination efforts with tribes, individuals, organizations, and agencies were conducted for the proposed leasing actions.

4.1 ENDANGERED SPECIES ACT CONSULTATION

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 RMP as amended in 1997 (Consultation #2-22-96-F-128). In April 2008, the BLM PDO Special Status Species RMPA 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: the LPC and the DSL. This action is also in compliance with threatened and endangered species management outlined in the September 2006 (Cons. #22420-2007-TA-0033) Biological Assessments and in accordance with the requirements of the FLPMA and NEPA.

Additionally, in July 2020, the BLM also completed a review of the current species listings within the vicinity of the nominated lease parcels using the USFWS IPaC system (Consultation Code: 02ENNM00-2020-SLI-1205 for Eddy County, and Consultation Code: 02ENNM00-2020-SLI-1206 for Lea County; USFWS 2020a). BLM would initiate Section 7 consultation with the USFWS in compliance with the ESA for species not previously analyzed in the 1997 RMP Biological Assessment (BLM 1997a) if during site selection federally listed species are found to have a potential to be present or impacted during lease development. If during site selection federally listed species are found to have a potential to be impacted during lease development, the BLM would initiate Section 7 consultation with the USFWS in compliance with the ESA. No further consultation with the USFWS is required at this stage.

Although not expected to be present, any federally listed fish species found to have a potential to be present or impacted during site selection would require a separate “effects determination” made at a site-specific project level to ensure that water used for drilling operations is properly permitted from existing legal sources (no new water depletions) and is in compliance with the ESA. Any new water depletion would likely require Section 7 consultation under the ESA.

While federal regulation and policies require the BLM to make its public land and resources available on the basis of the principle of multiple uses, it is BLM policy to conserve special status species and their habitats, and to ensure that actions authorized by the BLM do not contribute to the need for the species to become listed as Threatened or Endangered by the USFWS. Official species lists, whether obtained via IPaC or local USFWS offices, are valid for 90 days. After 90 days, project proponents should confirm their results on IPaC by requesting an updated official species list for their project.

4.2 TRIBAL CONSULTATION

Tribal consultation for the leasing actions is done on a government-to-government basis. On August 24, 2020, the BLM CFO initiated consultation with Ysleta del Sur Pueblo, Apache Tribe of Oklahoma, Pueblo of Isleta, Comanche Nation, Mescalero Apache Tribe, Kiowa Tribe of Oklahoma, and Hopi Tribe, with a request for response within 30 days of receipt. Tribal and Pueblo leaders were invited to participate in Government-to-Government consultation regarding the parcels nominated for the January 2021 Oil and Gas Lease Sale and were provided a letter and map describing the proposed lease sale parcels. Consultation is ongoing and the BLM CFO will be available to engage with Tribes and Pueblos and respond to any consultation requests.

The CFO received a response from the Ysleta del Sur Pueblo on August 27, 2020. In their response, Ysleta del Sur stated they do not have any comments on the proposed project and do not believe the project will adversely affect traditional, religious, or cultural sites significant to their Pueblo. However, Ysleta del Sur Pueblo requests consultation should any human remains or artifacts subject to the Native American Graves Protection and Repatriation Act (NAGPRA) be identified during development.

4.3 STATE HISTORIC PRESERVATION OFFICE AND TRIBAL HISTORIC PRESERVATION OFFICE CONSULTATION

Section 106 of the National Historic Preservation Act of 1966 (NHPA) and its implementing regulations (36 CFR Part 800) require federal agencies to consider what effect their licensing, permitting, funding, or otherwise authorizing an undertaking, such as an APD or right-of-way, may have on properties listed in or eligible for listing in the National Register of Historic Places (NRHP). 36 CFR 800.16 gives specific definitions for key cultural resource management concepts such as undertakings, effects, and areas of potential effects.

The New Mexico BLM has a two-party agreement with the SHPO that implements an authorized alternative to 36 CFR 800 for most undertakings (BLM and SHPO 2014). This agreement, called the State Protocol, offers a streamlined process for reporting and review that expedites consultation with the SHPO. However, certain circumstances, including intense public controversy over an undertaking, may result in the SHPO or BLM requiring use of the standard Section 106 consultation procedures outlined in 36 CFR 800 rather than the State Protocol.

The State Protocol details how the New Mexico BLM and SHPO consult and regulate their relationship. The State Protocol also outlines when case-by-case SHPO consultation is or is not required for specific undertakings, the procedures for evaluating the effects of common types of undertakings, and details how to resolve adverse effects on historic properties. These common types of undertakings regularly include actions undertaken by the BLM.

The BLM CFO cultural heritage resources specialists determined that there would be No Historic Properties Affected at this time as a result of the undertaking. The use of State Protocol Appendix C.I.a for this undertaking is appropriate because the lease sale itself does not directly authorize surface disturbance. Rather, leaseholders are granted future right of development to the leased mineral estate that is subject to site-specific analysis under NEPA and Section 106 of the NHPA at the stage of lease development. Such lease development activities are considered undertakings separate from the lease sale. These undertakings would be subject to additional detailed analysis under NEPA and Section 106. Any adverse effects identified for development of the lease parcel would be subject to mitigation or avoidance, as appropriate.

CHAPTER 5. LIST OF PREPARERS

Table 5.1 contains a list of individuals that contributed to preparation of this EA.

Table 5.1. List of EA Preparers

Name	Area of Expertise	Organization
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Hector Gonzalez	Carlsbad RMP Team Lead	BLM CFO
Tracie Hughes	Outdoor Recreation Planner	BLM CFO
Elia Perez	Archaeologist	BLM CFO
Cassandra Brooks	Wildlife Biologist	BLM CFO
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Name	**Area of Expertise**	**Organization**
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APPENDIX A. NOMINATED LEASE PARCELS FOR CARLSBAD FIELD OFFICE JANUARY 14, 2021 COMPETITIVE OIL AND GAS LEASE SALE

Table A.1. Nominated Lease Parcel Descriptions

Lease Parcel Number	Surface Ownership	Legal Description	Acres	Lease Notices and Stipulations
NM-2021-01-0361	BLM	NM T. 19 S., R. 34 E., NMPM Sec. 23 N2SE. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016464	80	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-17-CSU** BLM Stipulations for PDO - CSU - Slopes & Fragile Soils **SENM-S-22-CSU** BLM Stipulations for PDO - CSU – Lesser Prairie-Chickens **SENM-S-23-CSU** BLM Stipulations for PDO - CSU – Dunes Sagebrush Lizard **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource **SENM-LN-2** BLM Lease Notice Stipulations for PDO - LN – Dunes Sagebrush Lizard
NM-2021-01-0363	Private	NM T. 18 S., R. 29 E., NMPM Sec. 24 S2SE; Sec. 25 NENE. Eddy County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016492	120	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-22-CSU** BLM Stipulations for PDO - CSU - Lesser Prairie-Chickens **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource
NM-2021-01-0366	BLM	NM T. 17 S., R. 30 E., NMPM Sec: 29 E2NW. Eddy County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016492	80	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-17-CSU** BLM Stipulations for PDO - CSU - Slopes & Fragile Soils **SENM-S-18-CSU** BLM Stipulations for PDO - CSU - Streams, Rivers and Floodplains **SENM-S-22-CSU** BLM Stipulations for PDO - CSU - Lesser Prairie Chickens **SENM-S-23-CSU** BLM Stipulations for PDO - CSU - Dunes Sagebrush Lizard **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource **SENM-LN-2** BLM Lease Notice Stipulations for PDO - LN - Dunes Sagebrush Lizard

Lease Parcel Number	Surface Ownership	Legal Description	Acres	Lease Notices and Stipulations
NM-2021-01-0368	BLM / Private	NM T. 18 S., R. 32 E., NMPM Sec.14 SWSW. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016492	40	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-22-CSU** BLM Stipulations for PDO - CSU - Lesser Prairie Chickens **SENM-S-23-CSU** BLM Stipulations for PDO - CSU - Dunes Sagebrush Lizard **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource **SENM-LN-2** BLM Lease Notice Stipulations for PDO - LN - Dunes Sagebrush Lizard
NM-2021-01-0369	BLM	NM T. 18 S., R. 32 E., NMPM Sec. 24 NWNE. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016492	40	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-17-CSU** BLM Stipulations for PDO - CSU - Slopes & Fragile Soils **SENM-S-22-CSU** BLM Stipulations for PDO - CSU - Lesser Prairie Chickens **SENM-S-23-CSU** BLM Stipulations for PDO - CSU - Dunes Sagebrush Lizard **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource **SENM-LN-2** BLM Lease Notice Stipulations for PDO - LN - Dunes Sagebrush Lizard
NM-2021-01-0370	BLM	NM T. 18 S., R. 32 E., NMPM Sec. 26 SE. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016492	160	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-54-NSO** BLM Stipulations for PDO - NSO – Lesser Prairie Chicken Habitat Area **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource
NM-2021-01-0371	BLM	NM T. 19 S., R. 31 E., NMPM Sec. 3 S2SW. Eddy County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016492	80	**WO-ESA 7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-15-CSU** BLM Stipulations for PDO - CSU - Wildlife Habitat Projects **SENM-S-19-CSU** BLM Stipulations for PDO - CSU - Playas and Alkali Lakes **SENM-S-22-CSU** BLM Stipulations for PDO - CSU - Lesser Prairie-Chickens **NM-1-LN** BLM Lease Notice Stipulations for NMSO - LN - Potential, Suitable and Occupied Habitat for Special Status Plant Species **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource

Lease Parcel Number	Surface Ownership	Legal Description	Acres	Lease Notices and Stipulations
NM-2021-01-0372	State / Private	NM T. 15 S., R. 33 E., NMPM Sec. 1 LOTS 3-4, S2NW, SW; Sec. 12 W2NE, NW. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016492	576.51	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-19-CSU** BLM Stipulations for PDO - CSU - Playas and Alkali Lakes **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource
NM-2021-01-0374	Private	NM T. 15 S., R. 33 E., NMPM Sec. 8 S2NW. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016492	80	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-19-CSU** BLM Stipulations for PDO - CSU – Playas and Alkali Lakes **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource
NM-2021-01-0375	Private	NM T. 15 S., R. 33 E., NMPM Sec. 8 S2SW. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016492	80	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-19-CSU** BLM Stipulations for PDO - CSU – Playas and Alkali Lakes **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource
NM-2021-01-0376	State Land Office (SLO) / Private	NM T. 15 S., R. 33 E., NMPM Sec. 13 S2; Sec. 24 ALL. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016492	960	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-19-CSU** BLM Stipulations for PDO - CSU – Playas and Alkali Lakes **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource
NM-2021-01-0378	SLO / Private	NM T. 15 S., R. 33 E., NMPM Sec. 15 E2. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016492	320	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-19-CSU** BLM Stipulations for PDO - CSU – Playas and Alkali Lakes **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource
NM-2021-01-0379	Private	NM T. 15 S., R. 33 E., NMPM Sec. 21 E2. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016492	320	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource

Lease Parcel Number	Surface Ownership	Legal Description	Acres	Lease Notices and Stipulations
NM-2021-01-0380	Private	NM T. 16 S., R. 33 E., NMPM Sec. 5 Lot 8. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016492	40	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource
NM-2021-01-0381	SLO / Private	NM T. 16 S., R. 33 E., NMPM Sec. 35 S2S2. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016492	160	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-19-CSU** BLM Stipulations for PDO - CSU – Playas and Alkali Lakes **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource
NM-2021-01-0382	Private	NM T. 18 S., R. 33 E., NMPM Sec. 6 Lot 4. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016492	42.3	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-17-CSU** BLM Stipulations for PDO - CSU - Slopes & Fragile Soils **SENM-S-22-CSU** BLM Stipulations for PDO - CSU - Lesser Prairie Chickens **SENM-S-23-CSU** BLM Stipulations for PDO - CSU - Dunes Sagebrush Lizard **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource **SENM-LN-2** BLM Lease Notice Stipulations for PDO - LN - Dunes Sagebrush Lizard
NM-2021-01-0383	BLM	NM T. 18 S., R. 33 E., NMPM Sec. 8 E2NE. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016492	80	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-22-CSU** BLM Stipulations for PDO - CSU - Lesser Prairie Chickens **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource

Lease Parcel Number	Surface Ownership	Legal Description	Acres	Lease Notices and Stipulations
NM-2021-01-0384	BLM / Private	NM T. 19 S., R. 33 E., NMPM Sec. 22 E2SE, SWSE; Sec. 23 SWNW, W2SW. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016492	240	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-1-CSU** BLM Stipulations for PDO - CSU - Potash Area Stipulation **SENM-S-22-CSU** BLM Stipulations for PDO - CSU - Lesser Prairie Chickens **SENM-S-23-CSU** BLM Stipulations for PDO - CSU - Dunes Sagebrush Lizard **SENM-S-34-CSU** BLM Stipulations for PDO - CSU - Shinnery Oak Sand Dune Habitat Complex PDO **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource **SENM-LN-2** BLM Lease Notice Stipulations for PDO - LN - Dunes Sagebrush Lizard **SENM-LN-6** BLM Lease Notice Stipulations for PDO - LN – OG Development Within Designated Potash Area **Potash Lease Notation** (see Appendix C for description).
NM-2021-01-0386	Private	NM T. 15 S., R. 34 E., NMPM Sec. 33 SW. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016493	160	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-19-CSU** BLM Stipulations for PDO - CSU – Playas and Alkali Lakes **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource
NM-2021-01-0387	Private	NM T. 16 S., R. 34 E., NMPM Sec. 1 SW. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016493	160	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-19-CSU** BLM Stipulations for PDO - CSU – Playas and Alkali Lakes **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource
NM-2021-01-0388	Private	NM T. 16 S., R. 34 E., NMPM Sec. 4 S2SE. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016493	80	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-19-CSU** BLM Stipulations for PDO - CSU – Playas and Alkali Lakes **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource
NM-2021-01-0389	Private	NM T. 16 S., R. 34 E., NMPM Sec. 25 W2. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016493	320	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-19-CSU** BLM Stipulations for PDO - CSU – Playas and Alkali Lakes **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource

Lease Parcel Number	Surface Ownership	Legal Description	Acres	Lease Notices and Stipulations
NM-2021-01-0390	BLM / SLO	NM T. 19 S., R. 34 E., NMPM Sec. 9 SWSE. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016493	40	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-17-CSU** BLM Stipulations for PDO - CSU - Slopes & Fragile Soils **SENM-S-22-CSU** BLM Stipulations for PDO - CSU - Lesser Prairie Chickens **SENM-S-23-CSU** BLM Stipulations for PDO - CSU - Dunes Sagebrush Lizard **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource **SENM-LN-2** BLM Lease Notice Stipulations for PDO - LN - Dunes Sagebrush Lizard
NM-2021-01-0391	Private	NM T. 19 S., R. 35 E., NMPM Sec. 13 E2NE. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016493	80	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource
NM-2021-01-0392	Private	NM T. 16 S., R. 36 E., NMPM Sec. 5 Lot 1. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016493	50.68	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource
NM-2021-01-0393	Private	NM T. 19 S., R. 36 E., NMPM Sec. 18 Lots 3-4, E2SW. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016493	154.57	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource
NM-2021-01-0394	Private	NM T. 19 S., R. 36 E., NMPM Sec. 20 E2SW, W2SE; SEC. 29 NW, W2NE; Sec. 30 Lot 4, SENE, E2SW, SE. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016493, NM00016494	718.3	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-18-CSU** BLM Stipulations for PDO - CSU – Streams, Rivers and Floodplains **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource

Lease Parcel Number	Surface Ownership	Legal Description	Acres	Lease Notices and Stipulations
NM-2021-01-0398	SLO / Private	NM T. 18 S., R. 37 E., NMPM Sec. 17 SW. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016493	160	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-19-CSU** BLM Stipulations for PDO - CSU – Playas and Alkali Lakes **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource
NM-2021-01-6738	BLM	NM T.18, S., R. 29 E., NMPM Section: 23 N2NW Subdivisions. Eddy County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016490	80	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-22-CSU** BLM Stipulations for PDO - CSU - Lesser Prairie-Chickens **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource
NM-2021-01-6740	BLM / SLO	NM T. 18 S., R. 29 E., NMPM Sec. 33 NWSW. Eddy County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016489	40	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-18-CSU** BLM Stipulations for PDO - CSU - Streams, Rivers and Floodplains **SENM-S-19-CSU** BLM Stipulations for PDO - CSU – Playas and Alkali Lakes **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource
NM-2021-01-6741	BLM	NM T. 17 S., R. 31 E., NMPM Sec. 27 S2. Eddy County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016492	320	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **SENM-S-17-CSU** BLM Stipulations for PDO - CSU - Slopes & Fragile Soils **SENM-S-18-CSU** BLM Stipulations for PDO - CSU - Streams, Rivers and Floodplains **SENM-S-22-CSU** BLM Stipulations for PDO - CSU - Lesser Prairie Chickens **SENM-S-23-CSU** BLM Stipulations for PDO - CSU - Dunes Sagebrush Lizard **SENM-S-54-NSO** BLM Stipulations for PDO - NSO - Lesser Prairie Chicken Habitat Area **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource **SENM-LN-2** BLM Lease Notice Stipulations for PDO - LN - Dunes Sagebrush Lizard
NM-2021-01-6742	Private	NM T. 15 S., R. 37 E., NMPM Sec. 8 W2SW. Lea County, BLM CFO, BLM PDO 100 % US Mineral Interest EOI#NM00016493	80	**WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource

APPENDIX B. MAPS

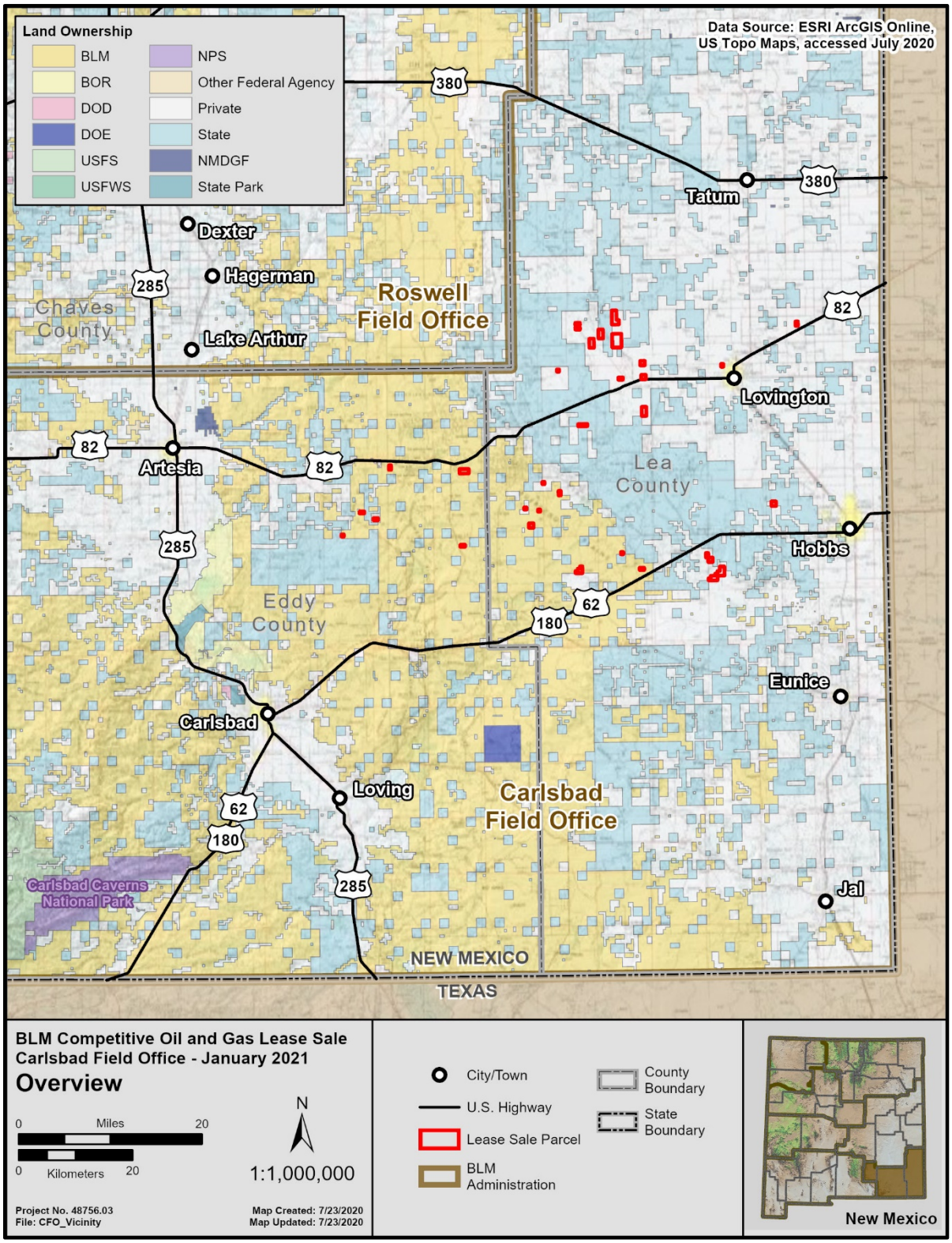

Figure B.1. Location of the 32 nominated lease parcels analyzed within this EA within the BLM Carlsbad Field Office.

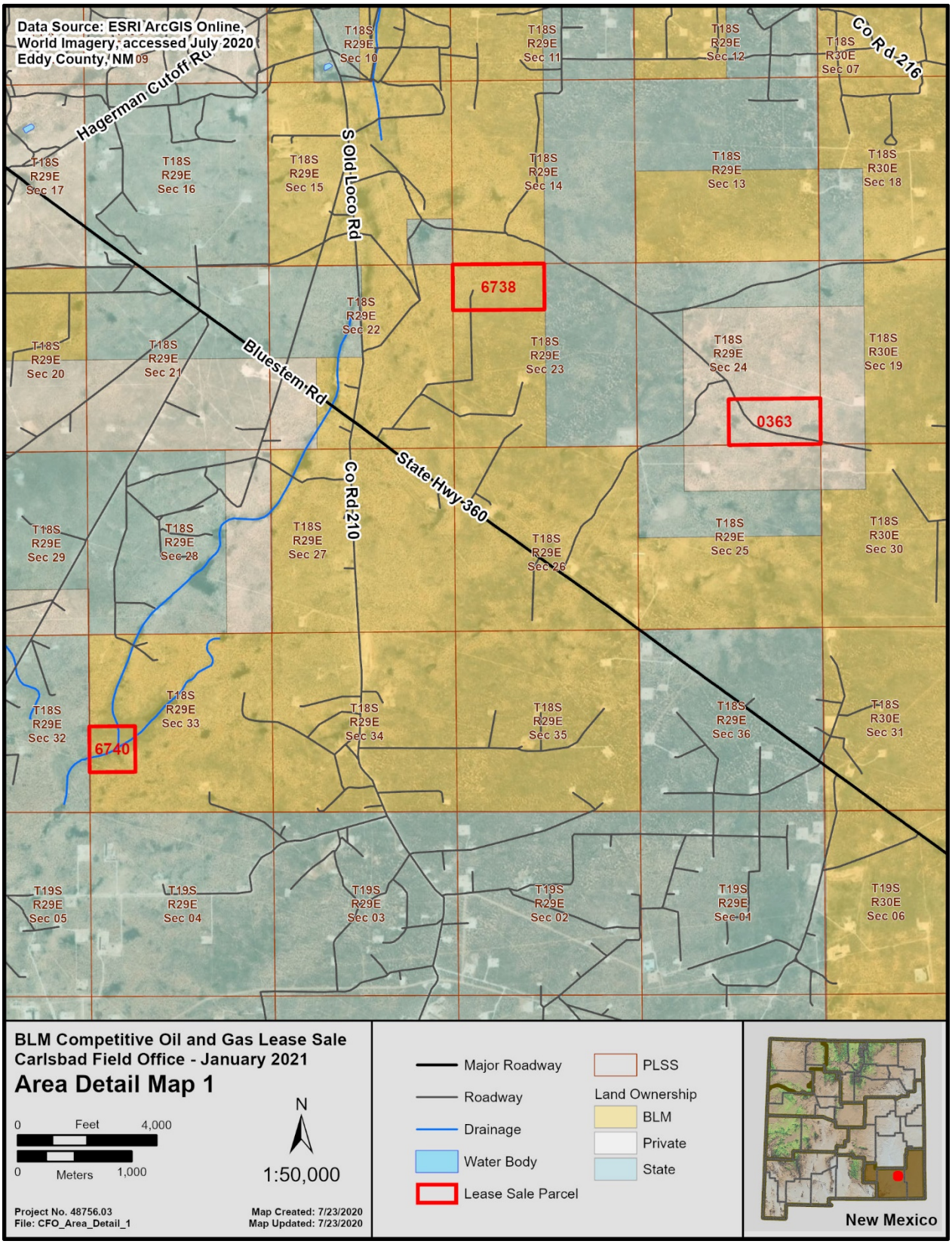

Figure B.2. Detail map of the nominated lease parcels analyzed in this EA within the Carlsbad Field Office (map 1 of 17).

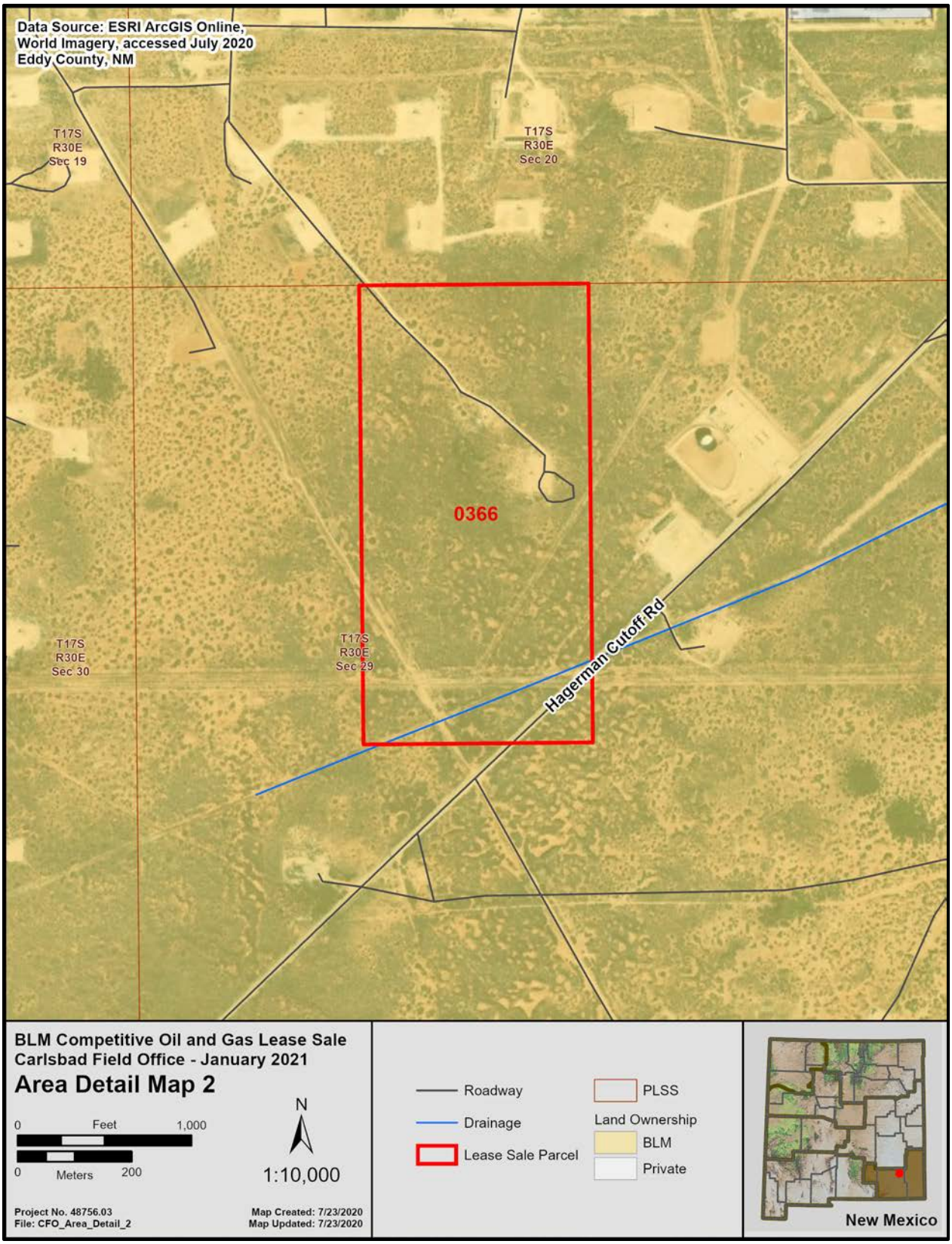

Figure B.3. Detail map of the nominated lease parcel analyzed in this EA within the Carlsbad Field Office (map 2 of 17).

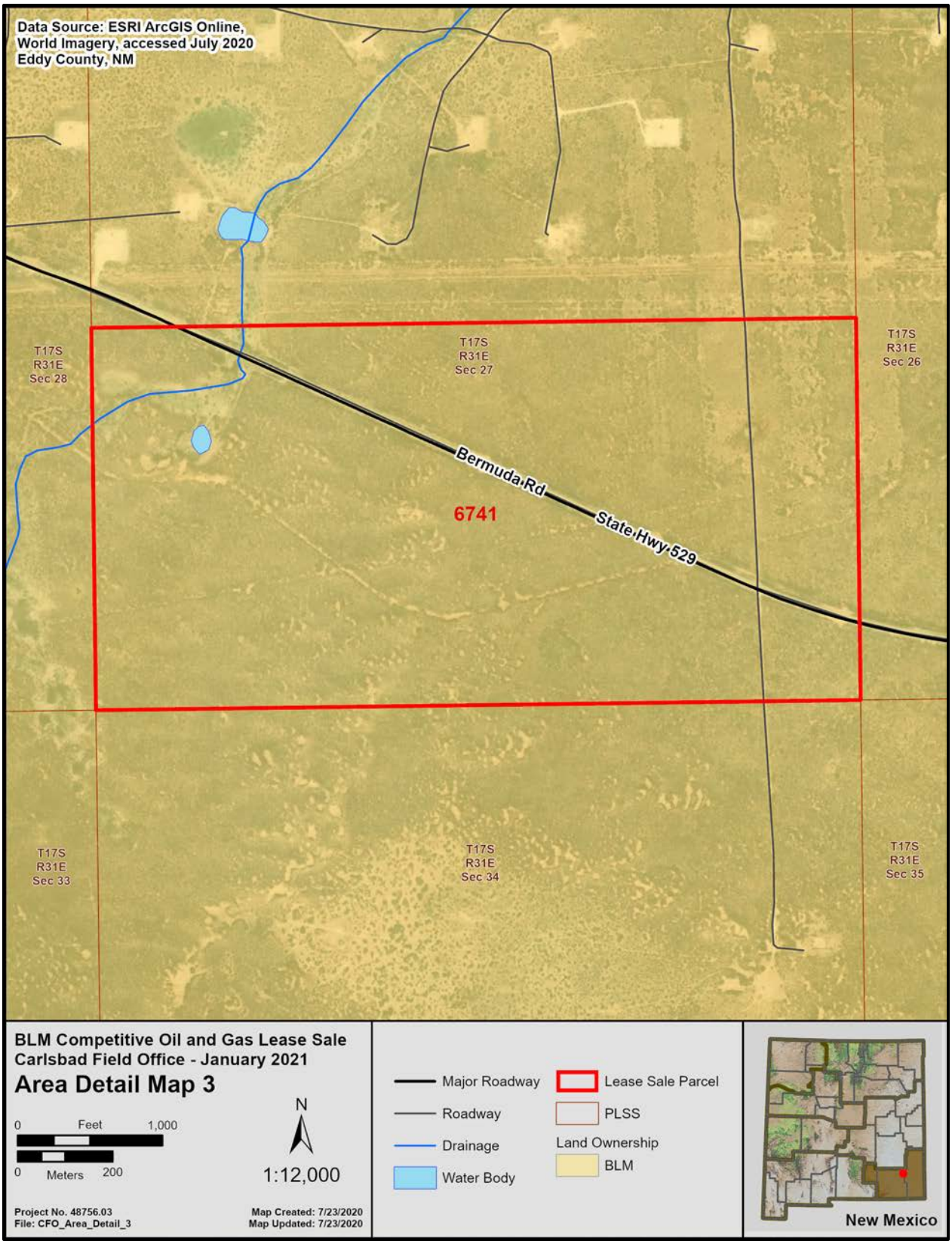

Figure B.4. Detail map of the nominated lease parcel analyzed in this EA within the Carlsbad Field Office (map 3 of 17).

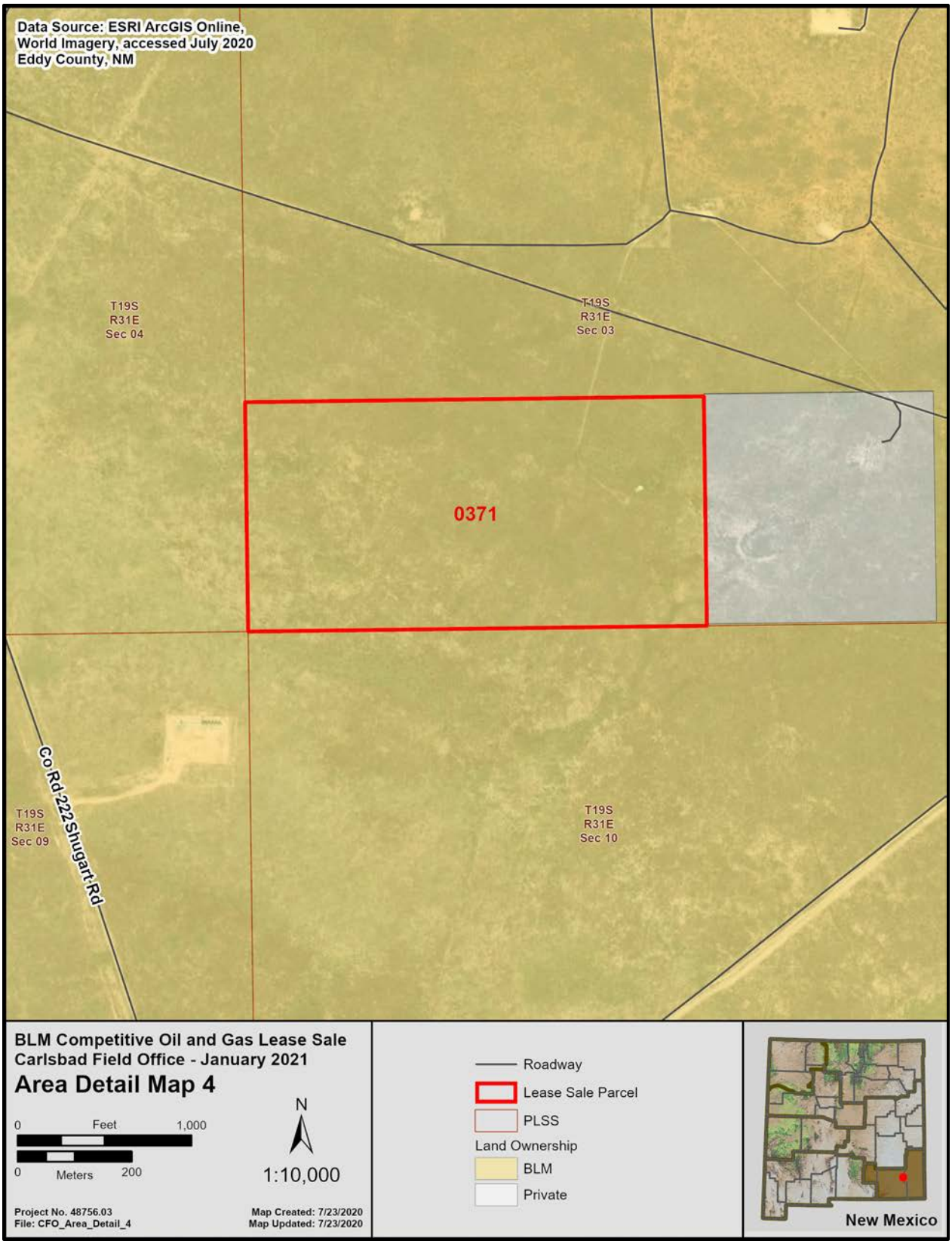

Figure B.5. Detail map of the nominated lease parcel analyzed in this EA within the Carlsbad Field Office (map 4 of 17).

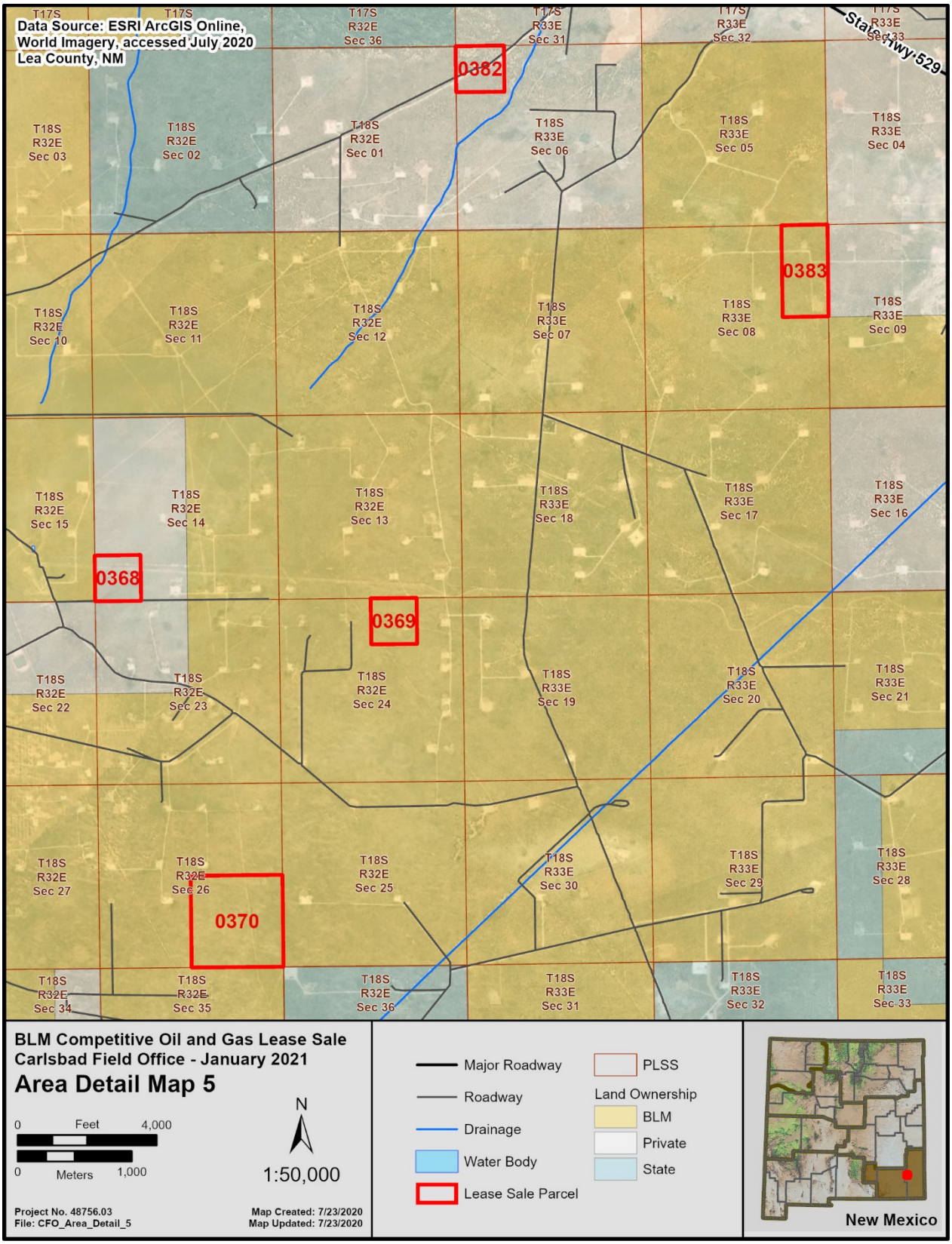

Figure B.6. Detail map of the nominated lease parcels analyzed in this EA within the Carlsbad Field Office (map 5 of 17).

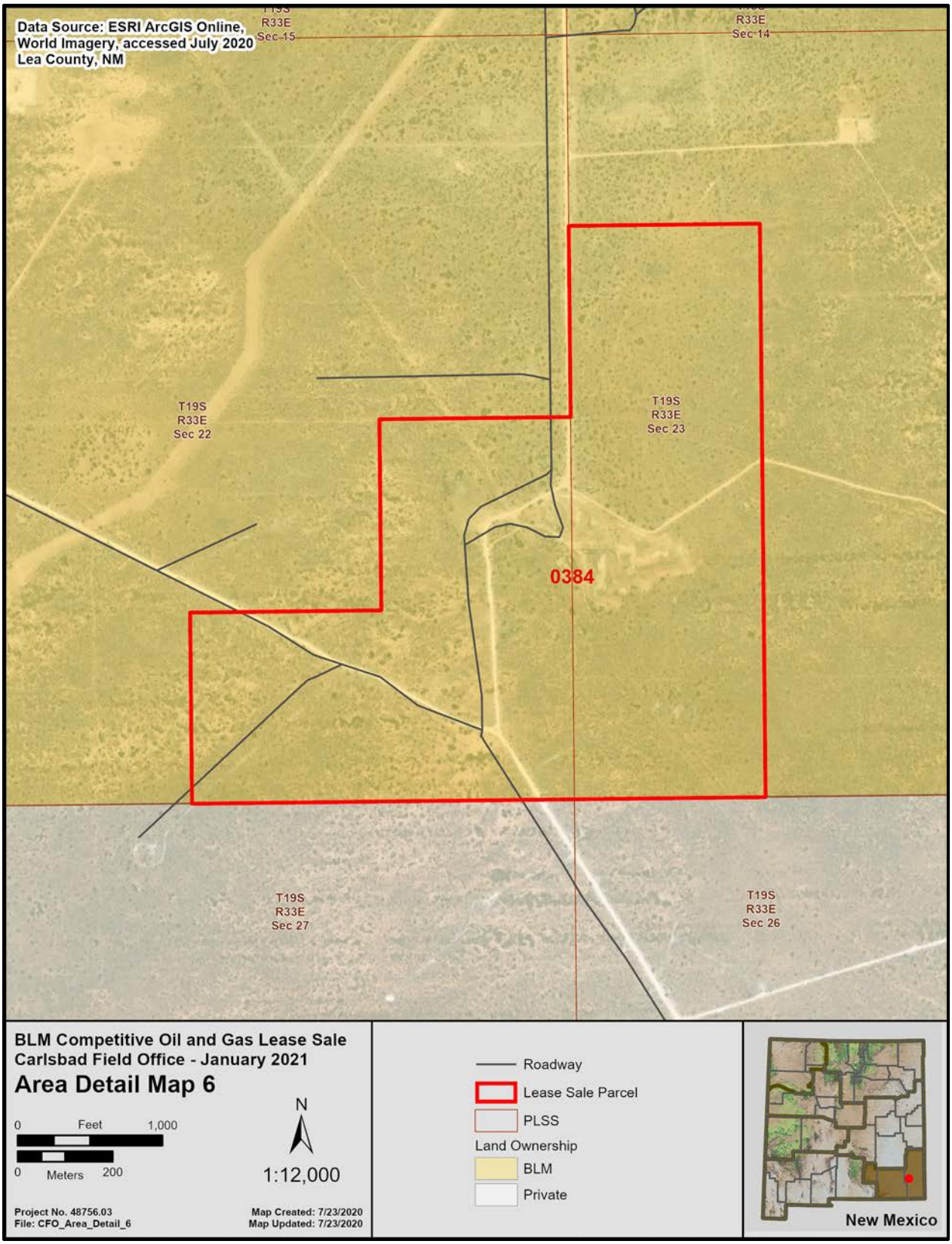

Figure B.7. Detail map of the nominated lease parcels analyzed in this EA within the Carlsbad Field Office (map 6 of 17).

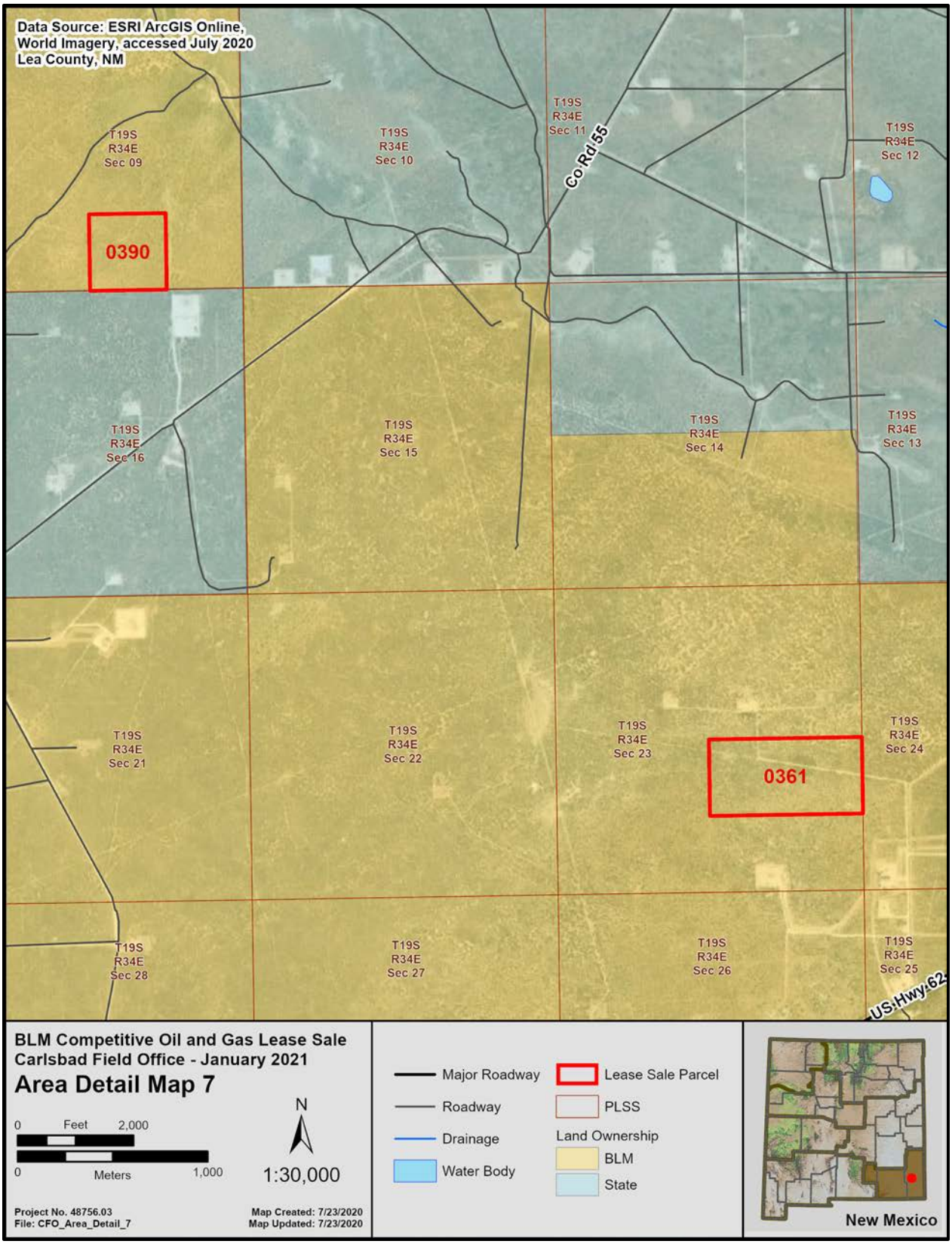

Figure B.8. Detail map of the nominated lease parcels analyzed in this EA within the Carlsbad Field Office (map 7 of 17).

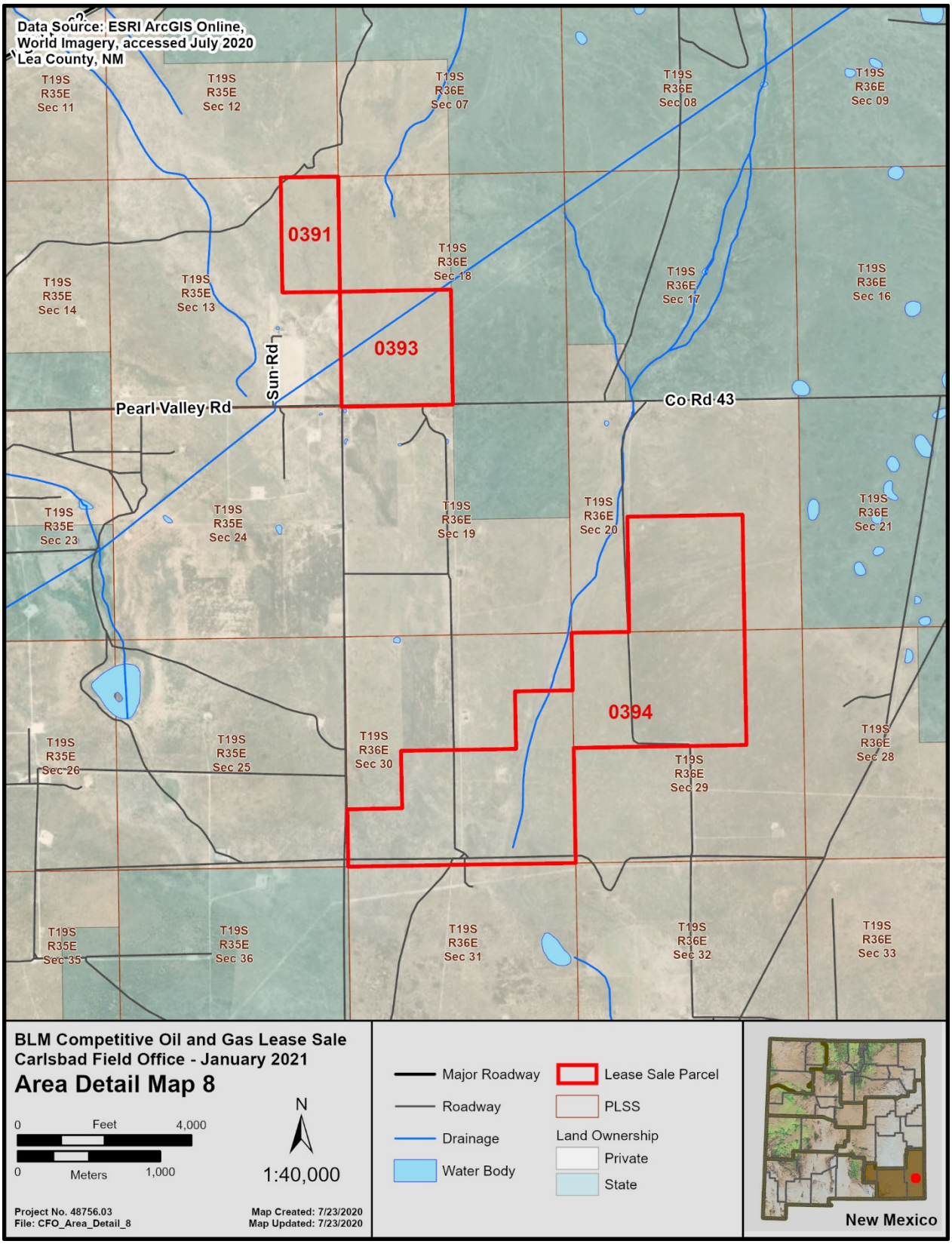

Figure B.9. Detail map of the nominated lease parcels analyzed in this EA within the Carlsbad Field Office (map 8 of 17).

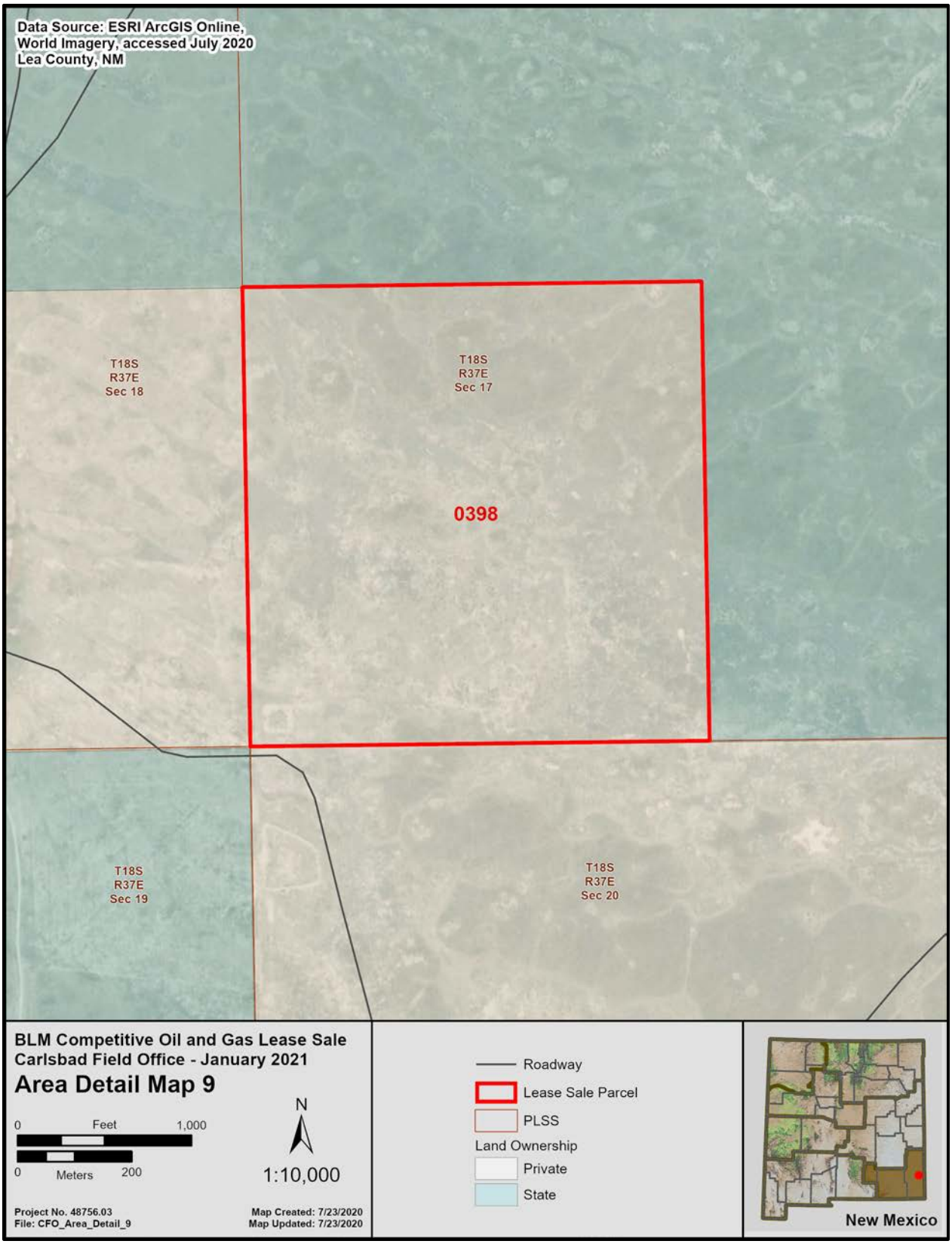

Figure B.10. Detail map of the nominated lease parcel analyzed in this EA within the Carlsbad Field Office (map 9 of 17).

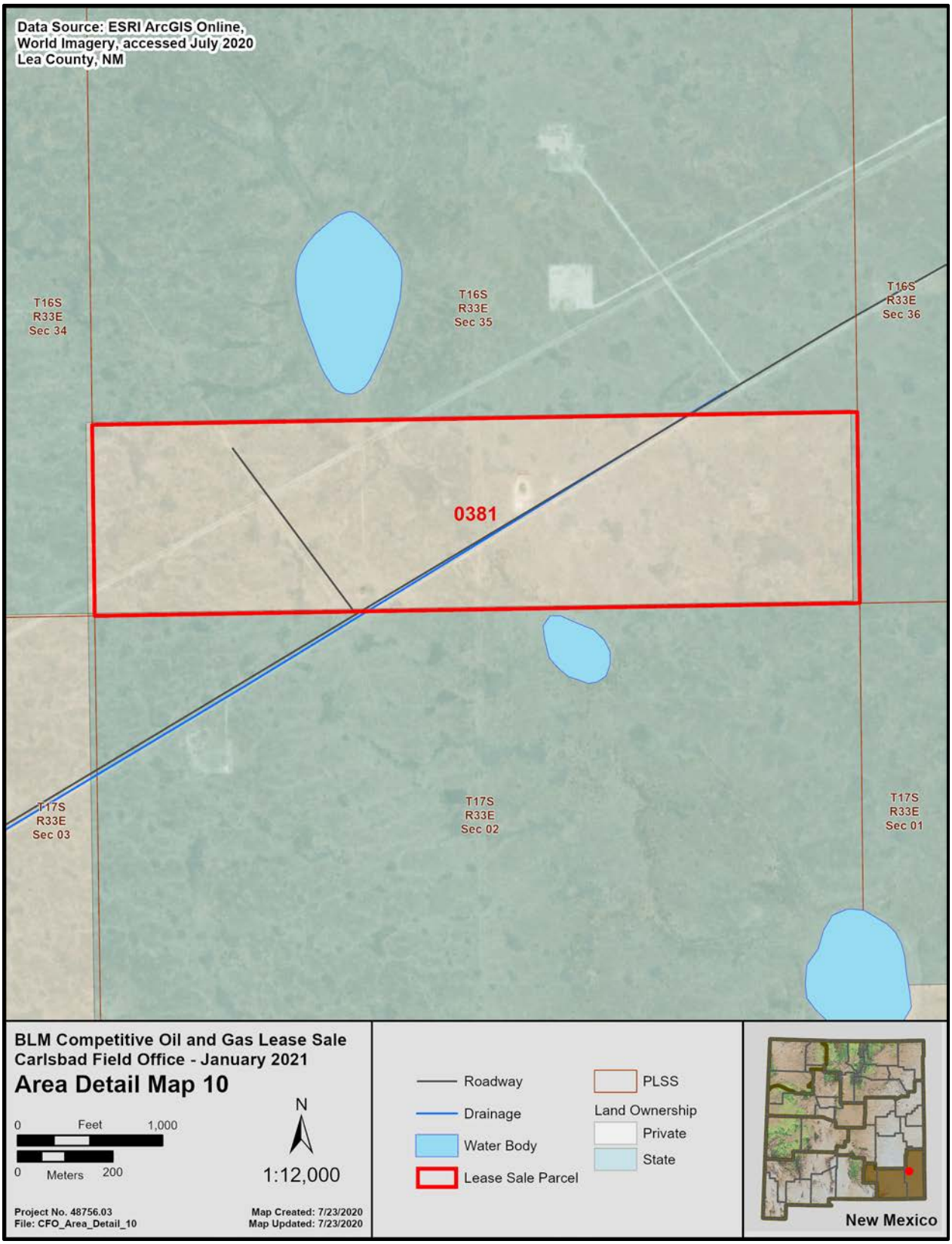

Figure B.11. Detail map of the nominated lease parcel analyzed in this EA within the Carlsbad Field Office (map 10 of 17).

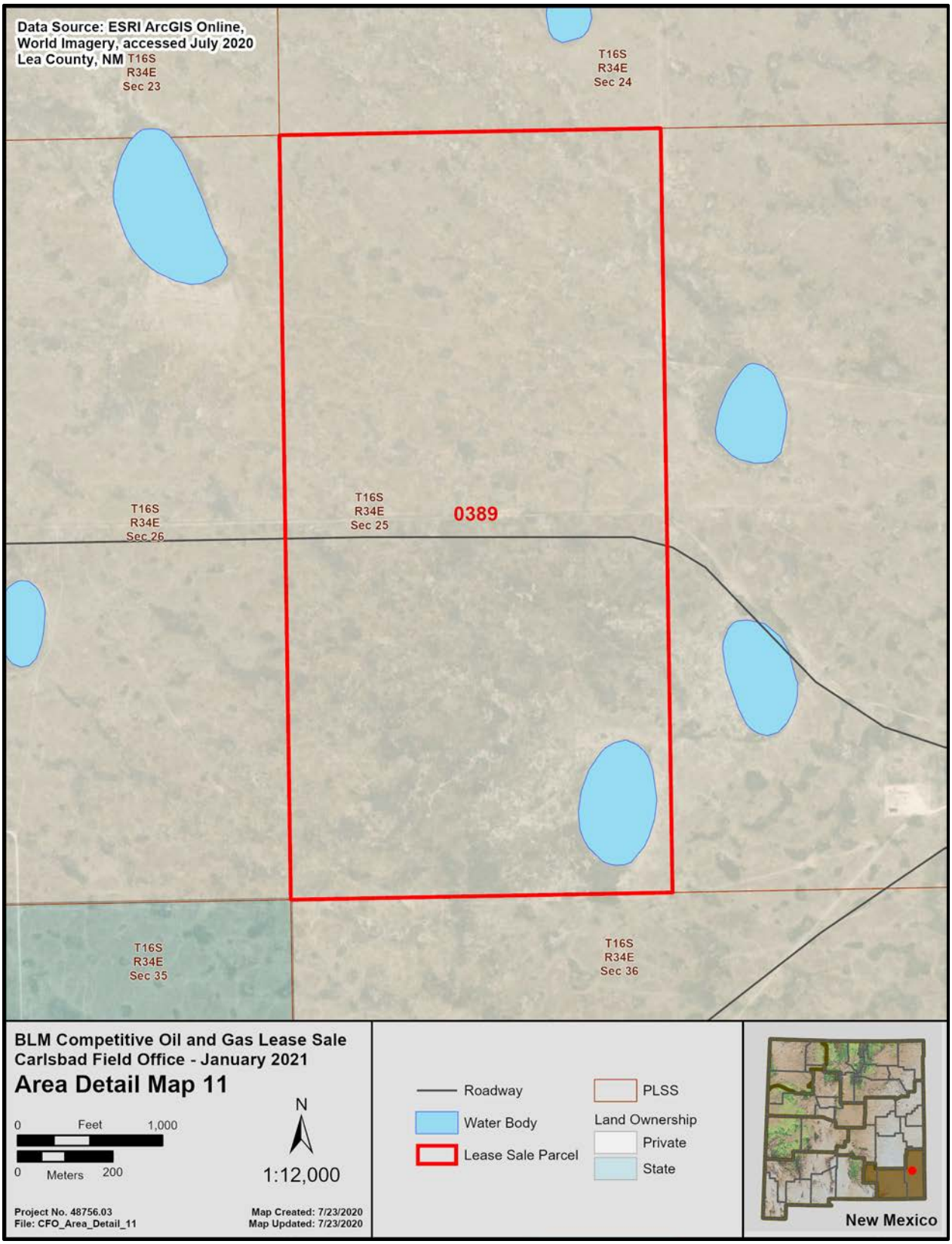

Figure B.12. Detail map of the nominated lease parcels analyzed in this EA within the Carlsbad Field Office (map 11 of 17).

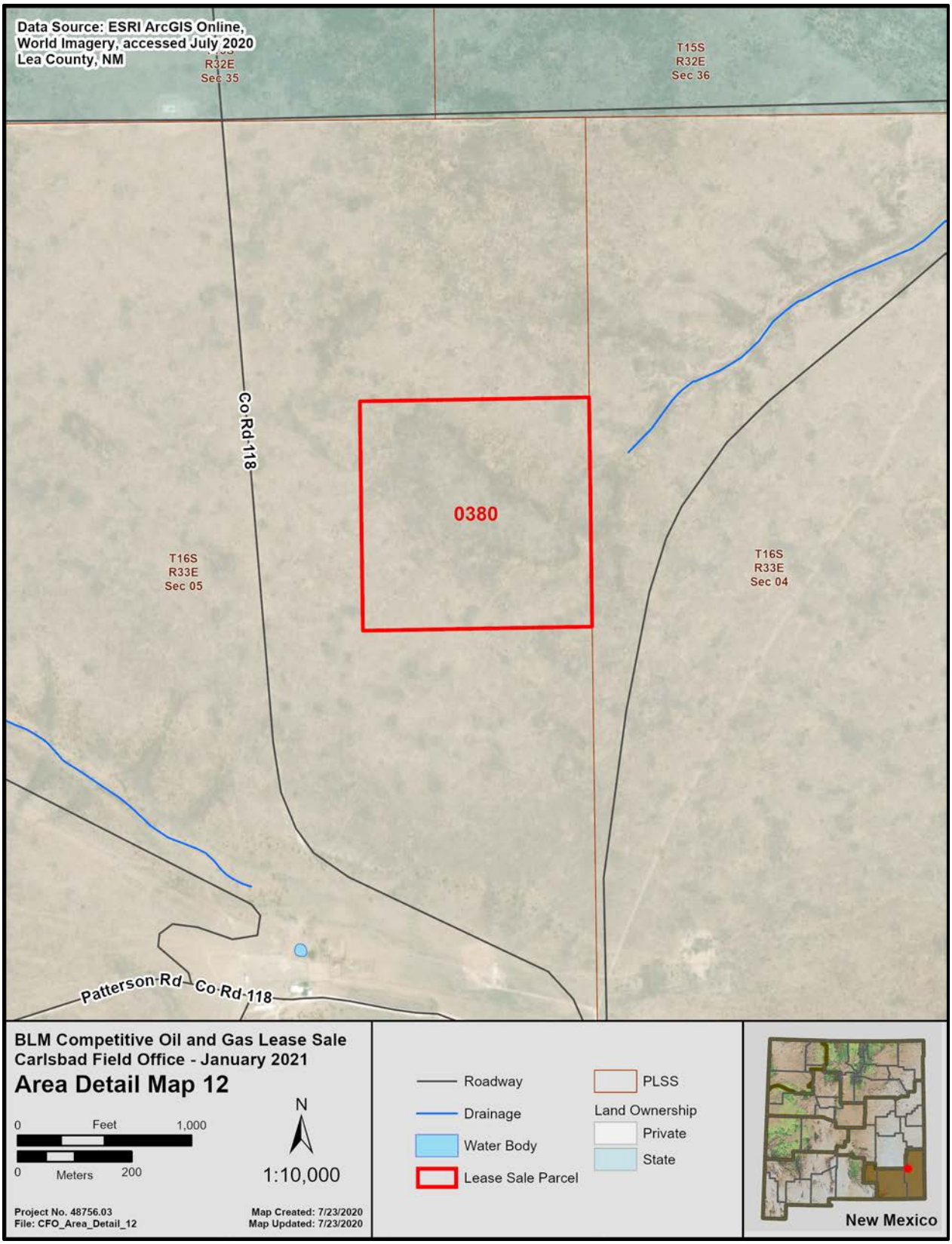

Figure B.13. Detail map of the nominated lease parcel analyzed in this EA within the Carlsbad Field Office (map 12 of 17).

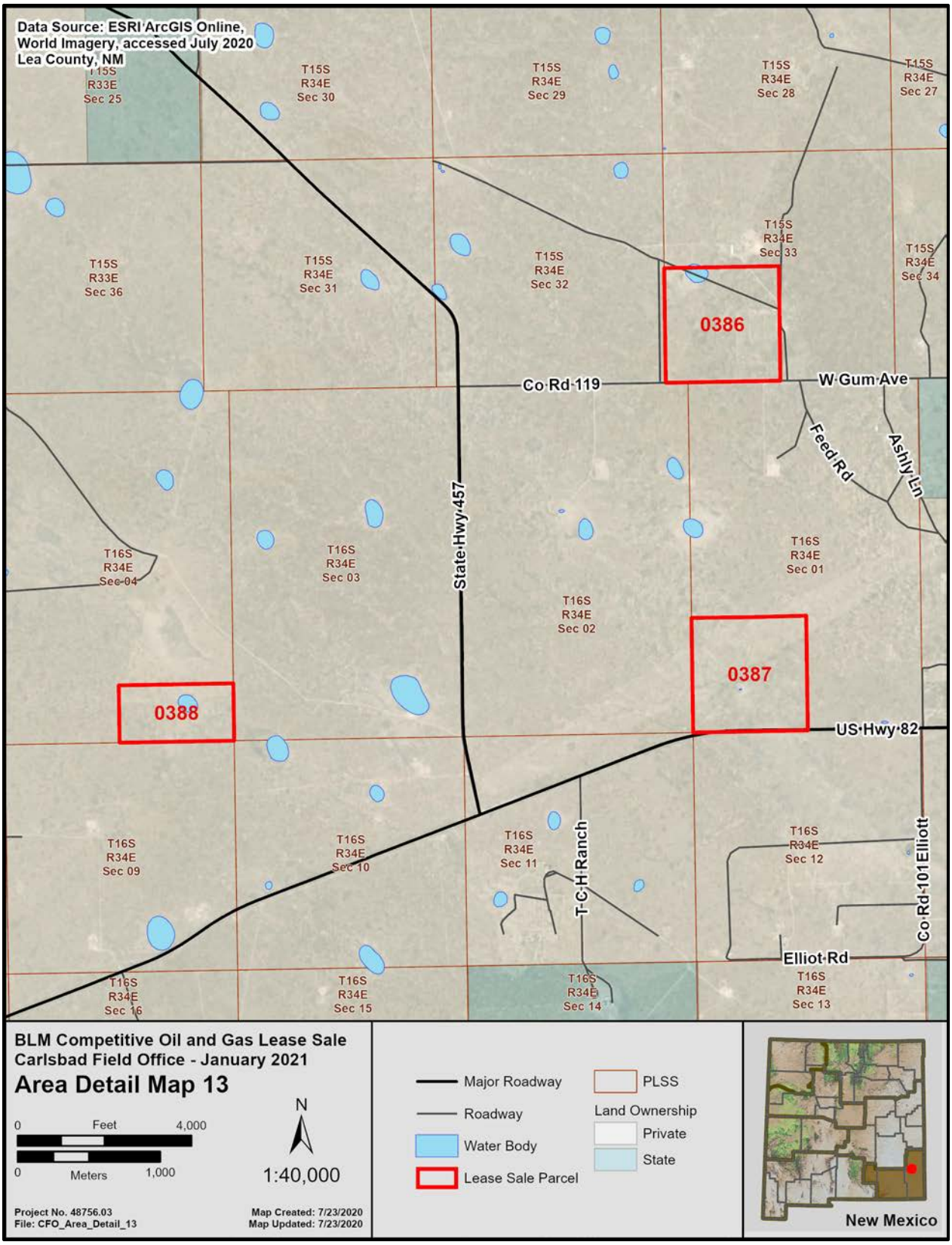

Figure B.14. Detail map of the nominated lease parcels analyzed in this EA within the Carlsbad Field Office (map 13 of 17).

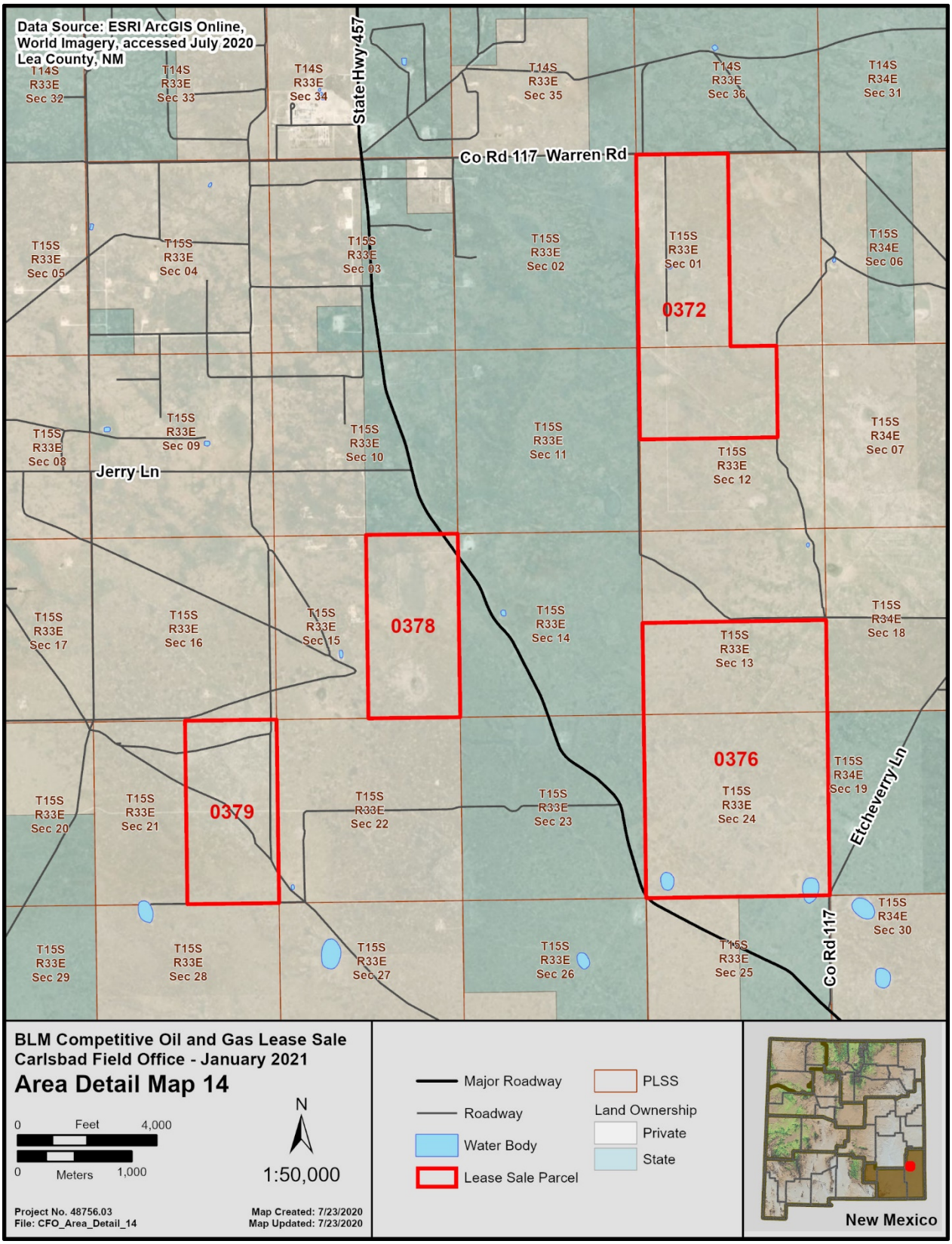

Figure B.15. Detail map of the nominated lease parcels analyzed in this EA within the Carlsbad Field Office (map 14 of 17).

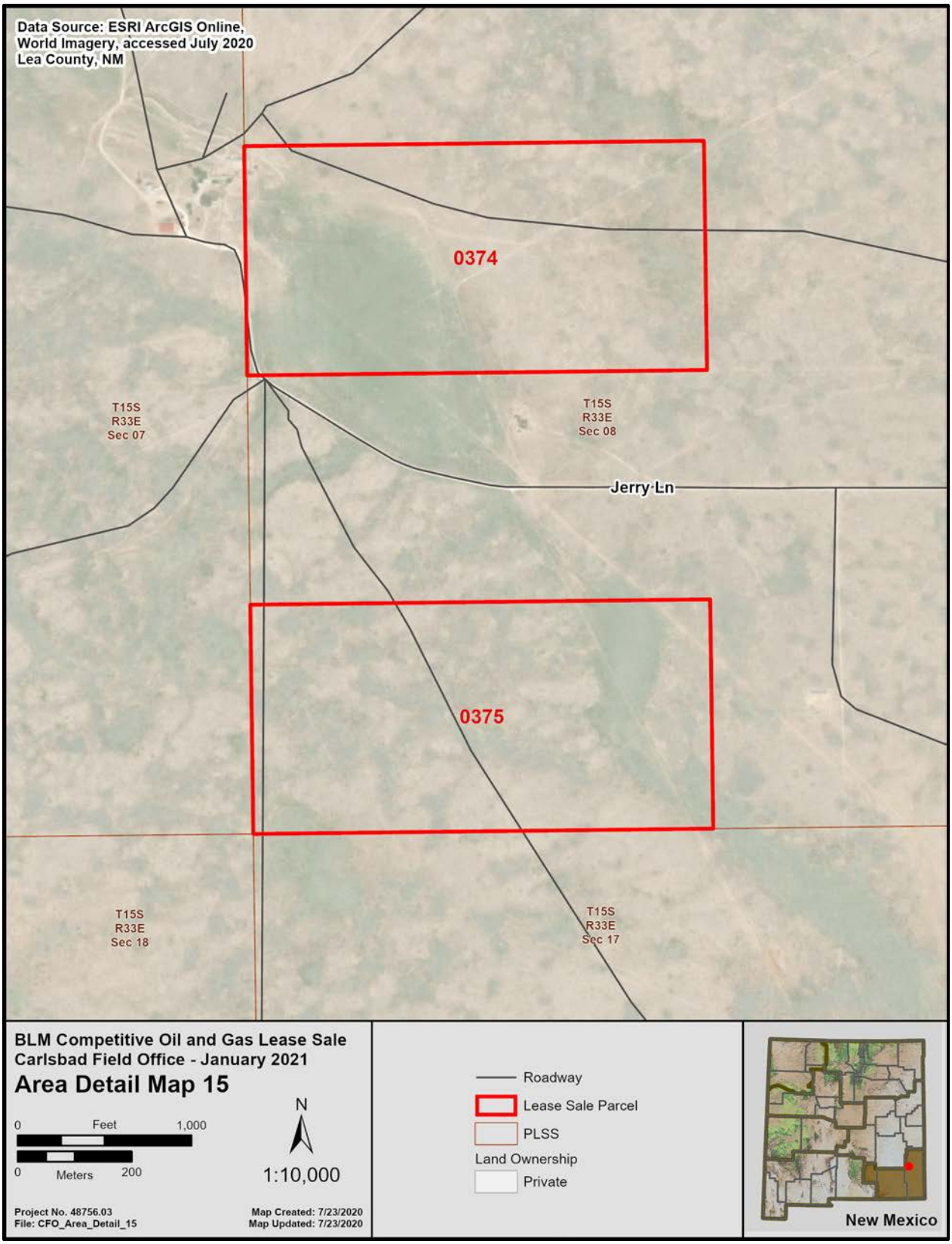

Figure B.16. Detail map of the nominated lease parcels analyzed in this EA within the Carlsbad Field Office (map 15 of 17).

Figure B.17. Detail map of the nominated lease parcels analyzed in this EA within the Carlsbad Field Office (map 16 of 17).

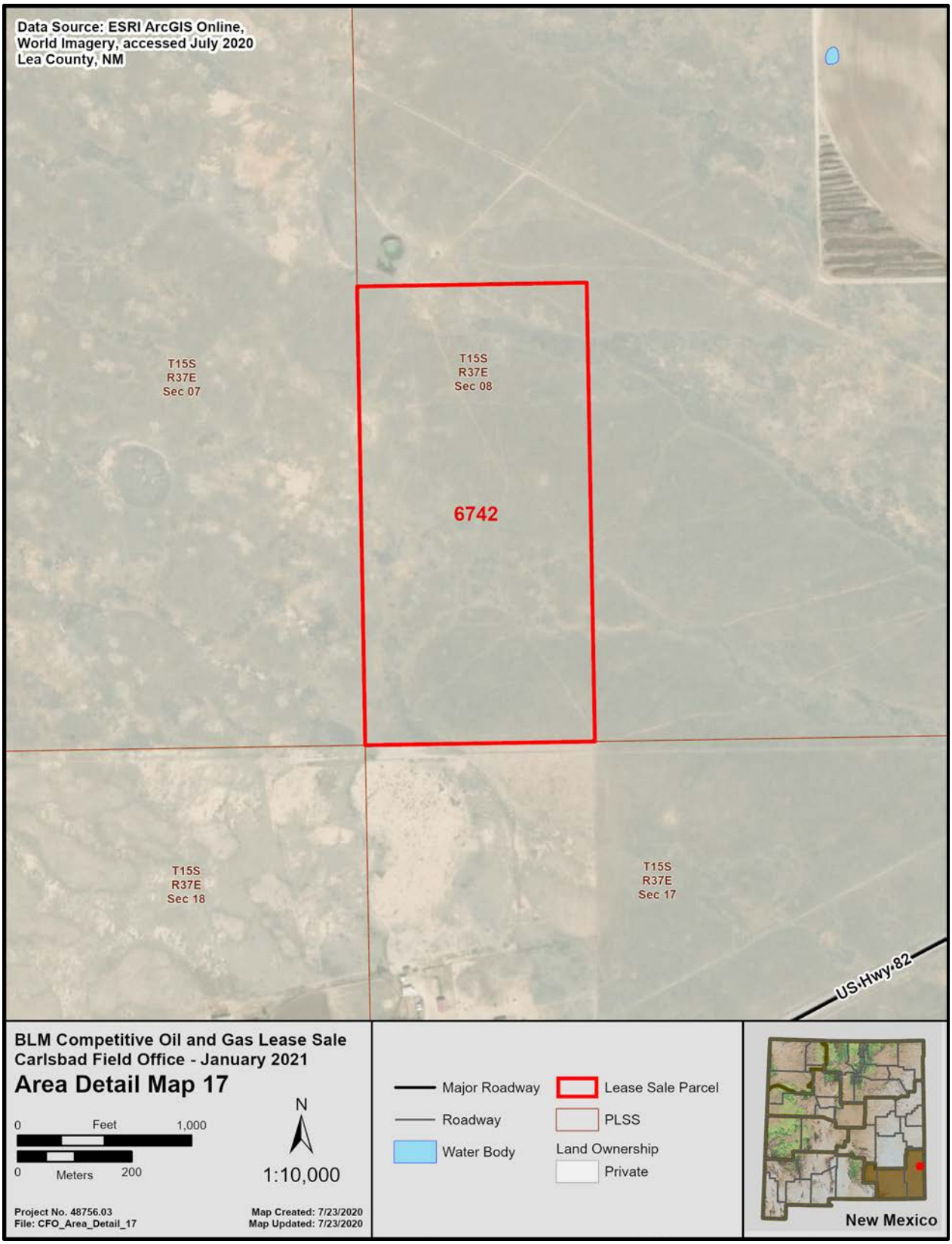

Figure B.18. Detail map of the nominated lease parcels analyzed in this EA within the Carlsbad Field Office (map 17 of 17).

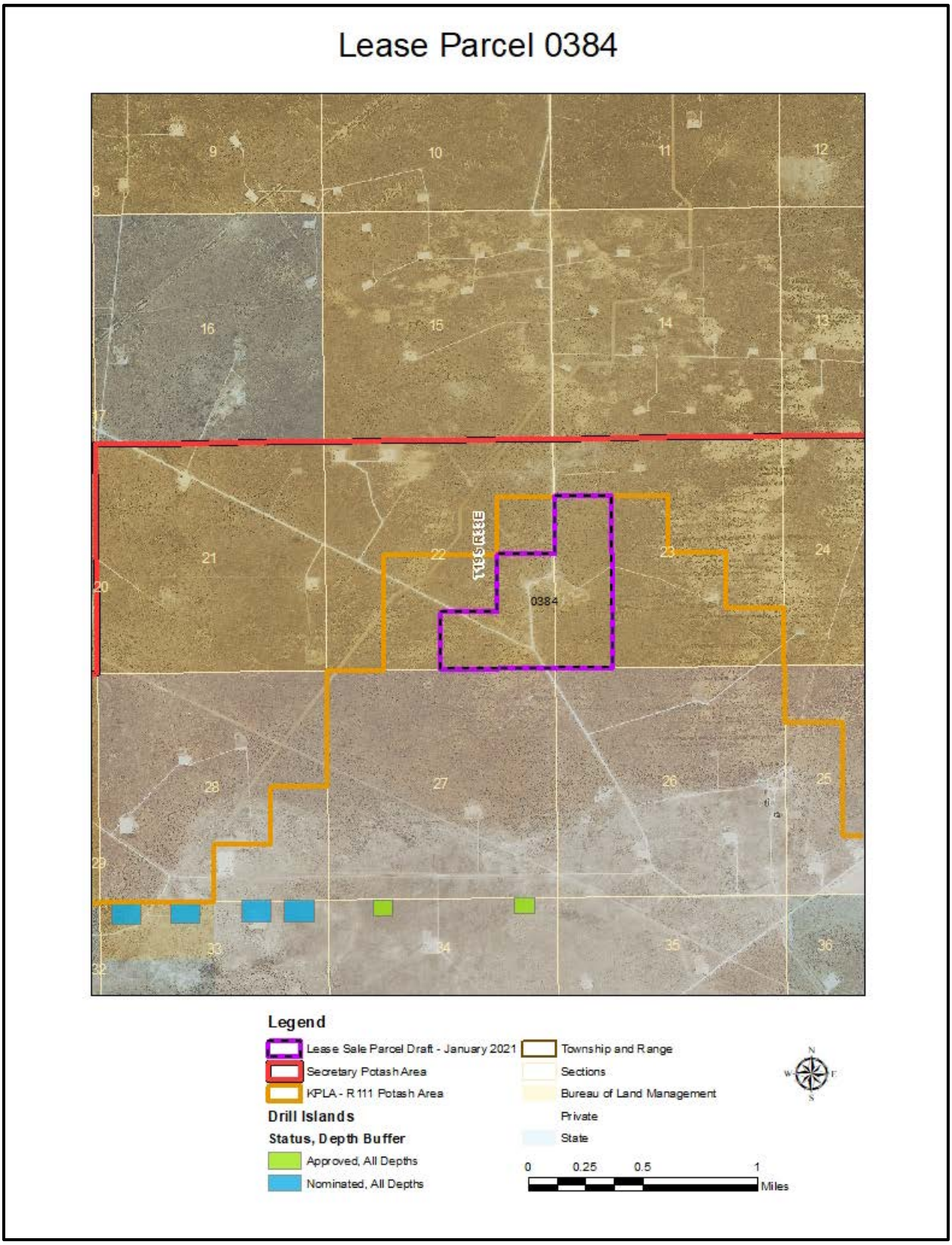

Figure B.19. Map of nominated lease parcel 384, detailing potash lease notation area within the Carlsbad Field Office.

APPENDIX C. CARLSBAD FIELD OFFICE LEASE STIPULATION AND LEASE NOTICE SUMMARY

Table C.1. Lease Stipulations and Lease Notices

Stipulation	Description/Purpose
NM-11-LN	**LEASE NOTICE – SPECIAL CULTURAL RESOURCE** All development activities proposed under the authority of this lease are subject to compliance with Section 106 of the NHPA and Executive Order 13007. The lease area may contain historic properties, traditional cultural properties (TCPs), and/or sacred sites currently unknown to the BLM that were not identified in the Resource Management Plan or during the lease parcel review process. Depending on the nature of the lease developments being proposed and the cultural resources potentially affected, compliance with Section 106 of the NHPA and Executive Order 13007 could require intensive cultural resource inventories, Native American consultation, and mitigation measures to avoid adverse effects—the costs for which will be borne by the lessee. The BLM may require modifications to or disapprove proposed activities that are likely to adversely affect TCPs or sacred sites for which no mitigation measures are possible. This could result in extended time frames for processing authorizations for development activities, as well as changes in the ways in which developments are implemented.
NM-1-LN	**LEASE NOTICE – SPECIAL STATUS PLANT SPECIES** The lease contains potential, suitable, and/or occupied habitat for special status plant species; therefore, special status plant species clearance surveys may be required prior to approving any surface-disturbing activities within or adjacent to BLM Special Status Plant Species' potential, suitable, and occupied habitats. Based on the results of the survey, conditions of approval may be applied to land use authorizations and permits that fall within the area of direct/indirect impacts or affected habitat, as appropriate. Possible mitigation strategies may include, but are not limited to avoidance/restriction of development, minimizing the area of disturbance, dust abatement measures, deterrents to reduce human disturbance, construction outside of the blooming season, specialized reclamation procedures, long-term monitoring of impacts, general oversight by qualified and independent third-party contractors, non-native or invasive species monitoring and control in occupied and suitable habitat, or any other on-site habitat protection or improvements.
SENM-LN-2	**LEASE NOTICE – PROTECTION OF DUNES SAGEBRUSH LIZARD (DSL)** This lease may encompass suitable and occupied habitat of the dunes sagebrush lizard (*Sceloporus arenicolus*). The lessee may be required to conduct an examination of the lands to determine the occurrence of the DSL (peak activity is May–August). Protocol for these surveys can be found in the 2008 Pecos District Special Status Species Resource Management Plan Amendment. The survey would be conducted by a qualified biologist or herpetologist approved by the BLM. A report of the findings would be submitted to the Authorized Officer. Exploration and lease development activities may be limited to areas outside of suitable or occupied habitat within the lease.
SENM-LN-6	**LEASE NOTICE – OIL AND GAS DEVELOPMENT WITHIN THE DESIGNATED POTASH AREA** This lease is located within the Secretary of the Interior's Designated Potash Area. It is subject to Secretarial Order No. 3324, signed December 3, 2012, the Federal Land Policy and Management Act (FLPMA), the Mineral Leasing Act (MLA) and regulations, orders, and directives of the Bureau of Land Management. The Order provides procedures and guidelines for more orderly co-development of oil, gas and potash deposits owned by the United States within the Secretary's Potash Area. Pursuant to applicable laws; the terms, conditions and attached stipulations to the Lease; the Secretary of the Interior's formal orders; and regulations; drilling of an oil and gas well from a surface location within the Designated Potash Area will only be permitted if drilling occurs under the following conditions: (1) a Drilling Island associated with a Development Area established under this Order or a Drilling Island established under a prior Order; (2) a Barren Area and the Authorized Officer (AO) determines that such operations will not adversely affect active or planned potash mining operations in the immediate vicinity of the proposed drill-site; or, (3) a Drilling Island, not covered by (1) above, or single well site established under this Order by the approval and in the sole discretion of the AO, provided that such site was jointly recommended to the AO by the oil and gas lessee(s) and the nearest potash lessee(s). In addition, the lessee may be required to participate in an approved Development Area.
SENM-S-1	**CONTROLLED SURFACE USE – OIL AND GAS DEVELOPMENT WITHIN THE DESIGNATED POTASH AREA** All or a portion of the lease is located within the Secretary of the Interior's Designated Potash Area. It is subject to Secretarial Order No. 3324, signed December 3, 2012. Pursuant to applicable laws; the terms, conditions and attached stipulations to the Lease; the Secretary of the Interior's formal orders; and regulations; this lease is subject to special requirements.

Stipulation	Description/Purpose
SENM-S-15	**CONTROLLED SURFACE USE – PROTECTION OF WILDLIFE HABITAT PROJECTS** Surface disturbance will not be allowed within up to 200 meters of existing or planned wildlife habitat improvement projects. Large-scale vegetation manipulation projects such as prescribed burns will be excepted. This requirement will be considered for waiver with appropriate off-site mitigation, as determined by the Authorized Officer.
SENM-S-17	**CONTROLLED SURFACE USE – PROTECTION OF SLOPES OR FRAGILE SOILS** Surface disturbance will not be allowed on slopes over 30%. Occupancy or use of fragile soils will be considered on a case-by-case basis.
SENM-S-18	**CONTROLLED SURFACE USE – PROTECTION OF STREAMS, RIVERS, FLOODPLAINS** Surface disturbance will not be allowed within up to 200 meters of the outer edge of 100-year floodplains, to protect the integrity of those floodplains.
SENM-S-19	**CONTROLLED SURFACE USE – PROTECTION OF PLAYAS AND ALKALI LAKES** Surface disturbance will not be allowed within up to 200 meters from the edge of playas or alkali lakes.
SENM-S-22	**CONTROLLED SURFACE USE – PROTECTION OF LESSER PRAIRIE-CHICKEN (LPC)** Drilling for oil and gas, and 3-D geophysical exploration operations will not be allowed in lesser prairie-chicken habitat during the period of March 1 through July 15, each year. During that period, other activities that produce noise or involve human activity, such as the maintenance of oil and gas facilities, geophysical exploration other than 3-D operations, and pipeline, road, and well pad construction, will be allowed except between 3:00 a.m. and 9:00 a.m. Additionally, no new drilling will be allowed within up to 200 meters of leks known at the time of permitting. Normal vehicle use on existing roads will not be restricted. Exhaust noise from pump jack engines must be muffled or otherwise controlled so as not to exceed 75 dB measured at 30 feet from the source of the noise. Open-top tanks, disposal pits, or other open pits will be required to be covered with a fine mesh netting to make them inaccessible to avian species and other wildlife. A low-profile marker will be required for a plugged or abandoned well. The well marker must be approximately 2 inches above ground level.
SENM-S-23	**CONTROLLED SURFACE USE – PROTECTION OF DUNES SAGEBRUSH LIZARD (DSL)** Surface disturbance will not be allowed in documented occupied habitat areas, or within up to 200 meters of suitable habitat associated with occupied habitat areas identified through field review.
SENM-S-34	**CONTROLLED SURFACE USE – SHINNERY OAK SAND DUNE HABITAT COMPLEX PLAN OF DEVELOPMENT** A plan of development (POD) for the entire lease must be submitted for review and approval, including NEPA analysis, by the BLM, prior to approval of development actions (APD, Sundry Notices). The POD must indicate planned access to well facilities (roads, pipelines, power lines), and the approximate location of well sites. Should it become necessary to amend the POD, the amendment must be approved prior to approval of subsequent development actions. Deviations from a current POD are not authorized until an amended POD has been approved by BLM.
SENM-S-54	**NO SURFACE OCCUPANCY – PROTECTION OF LESSER PRAIRIE CHICKEN HABITAT AREA** Preventing habitat loss and minimizing development impacts in the QP-F, QP-C, QP-A, QP-D, Skeen, Eunice and Mills lesser prairie-chicken Habitat Areas established for the potential to re-establish connectivity to adjacent isolated habitat blocks (2008 Pecos District Special Status Species Resource Management Plan Amendment). Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see Bureau of Land Management Manuals 1624 and 3101 or Forest Service Manuals 1950 and 2820.
WO-ESA-7	**ENDANGERED SPECIES ACT SECTION 7 CONSULTATION** The lease area may now or hereafter contain plants, animals, or their habitats determined to be threatened, endangered, or other special status species. BLM may recommend modifications to exploration and development proposals to further its conservation and management objective to avoid BLM-approved activity that will contribute to a need to list such a species or their habitat. BLM may require modifications to or disapprove proposed activity that is likely to result in jeopardy to the continued existence of a proposed or listed threatened or endangered species or result in the destruction or adverse modification of a designated or proposed critical habitat. BLM will not approve any ground-disturbing activity that may affect any such species or critical habitat until it completes its obligations under applicable requirements of the Endangered Species Act as amended, 16 U.S.C. § 1531 et seq., including completion of any required procedure for conference or consultation.

Stipulation	Description/Purpose
WO-NHPA	**CULTURAL RESOURCES AND TRIBAL CONSULTATION** This lease may be found to contain historic properties and/or resources protected under the National Historic Preservation Act (NHPA), American Indian Religious Freedom Act, Native American Graves Protection and Repatriation Act, Executive Order 13007, or other statutes and executive orders. The BLM will not approve any ground-disturbing activities that may affect any such properties or resources until it completes its obligations (e.g., State Historic Preservation Officer (SHPO) and tribal consultation) under applicable requirements of the NHPA and other authorities. The BLM may require modification to exploration or development proposals to protect such properties or disapprove any activity that is likely to result in adverse effects that cannot be successfully avoided, minimized, or mitigated.
Potash Lease Notation	**LEASE NOTATION – PARCEL 384 Sec. 22 E2SE, SWSE and Sec. 23 SWNW, W2SW T0220S, R0290E (240 acres)** This lease is located within the Secretary of the Interior's Designated Potash Area and is subject to Secretarial Order No. 3324, signed December 3, 2012. Drilling an oil and gas well within this lease may result in undue waste of potash deposits, constitute a hazard to or unduly interfere with mining operations being conducted for the extraction of potash deposits. Therefore, drilling of an oil and gas well from a surface location within this lease may not be allowed, and may only be permitted if drilling occurs from either the approved Jade Drilling Island located on fee surface along the northern section line of Section 27, T19S, R33E, or from the northern section line of Sections 22 and 23, T19S, R33E, on federal surface (see map B.18). A drilling island is not required if the well is drilled from the northern section lines of Sections 22 and 23, T19S, R33E. Access to the lease could also be accomplished from outside of the Secretary's Potash Area in Sections 14 and 15 in T19S, R33E. Regardless of where surface access occurs, a Development Area Notification will be required.

APPENDIX D. SUMMARY OF THE TYPICAL PHASES OF OIL AND GAS DEVELOPMENT

INTRODUCTION

The phases of oil and gas development include construction, drilling operations, completion operations, hydraulic fracturing, and production. During the construction activity phase, the area is cleared of vegetation and the pad is constructed. Throughout the drilling operation phase, equipment is moved on site and used to install the drill rig and other associated infrastructure. At this stage the well is drilled. Well completion follows well drilling. Well completion includes setting the casing to depth, cementing the casing,[13] and perforating the casing in target zones. If a well is going to be drilled directionally,[14] horizontally,[15] or vertically[16] this phase may be followed by hydraulic fracturing which involves pumping fracturing fluid into a formation at a calculated, predetermined rate and pressure to generate fractures or cracks in the target formation. The production phase begins when the well starts producing. The well abandonment and reclamation phases occur after the productive life of the well has concluded. Well abandonment and reclamation involve plugging wells and reclaiming the surface according to BLM guidelines and requirements.

Construction Activities

First, new construction areas need to be cleared of all vegetation. Clearing of the proposed well pad and access road are typically limited to the smallest area possible to provide safe and efficient work areas for all phases of construction. All clearing activities are accomplished by cutting, mowing, and/or grading vegetation as necessary. Cut vegetation may be mulched and spread on site or hauled to a commercial waste disposal facility.

Next, heavy equipment, including but not limited to, bulldozers, graders, front-end loaders, and/or track hoes are used to construct the pad, along with other features, as needed for development. Other features may include, but are not limited to, an access road, reserve pit, pipeline, and/or fracturing pond. Cut and fills may be required to level the pad or road surfaces. Reserve pits, if authorized, are lined using an impermeable liner or other lining mechanism (i.e., bentonite or clay) to prevent fluids from leaching into the soil. Access roads may have cattle guards, gates, drainage control, or pull-outs installed, among a host of other features that may be necessary based on the site-specific situation. Long-term surface

[13] According to BLM regulations from 43 CFR 3160: Onshore Order No. 2, casing and cementing programs are conducted to protect and/or isolate all usable water zones, lost circulation zones, abnormally pressured zones, and any prospectively valuable deposits of minerals. The casing setting depth is calculated to position the casing seat opposite a competent formation which will contain the maximum pressure to which it will be exposed during normal drilling operations. Determination of casing setting depth is based on all relevant factors, including presence/absence of hydrocarbons; fracture gradients; usable water zones; formation pressures; lost circulation zones; other minerals; or other unusual characteristics. Any isolating medium other than cement shall receive approval prior to use. The deepest casing may not be cemented and may remain open hole depending on the type of formation it is located in.

[14] Vertical drilling is the process of drilling a well from the surface vertically to a subsurface location where the target oil or gas reservoir is located (USDOE 2015).

[15] Horizontal drilling is the process of drilling a well from the surface to a subsurface location just above the target oil or gas reservoir called the "kickoff point," then deviating the well bore from the vertical plane around a curve to intersect the reservoir at the "entry point" with a near-horizontal inclination, and remaining within the reservoir until the desired bottom hole location is reached (North Dakota Department of Mineral Resources [NDDMR] 2008).

[16] Directional drilling is the process of controlling the direction and deviation of drilling a well from the surface to a subsurface location without disturbing the land directly above the target oil or gas reservoir (USDOE 2015).

disturbances such as pads and roads are typically surfaced with a layer of crushed rock. Areas not needed for long-term development are reclaimed by recontouring the surface and re-establishing vegetation.

A pipeline, if needed, is laid within a right-of-way that is first cleared of vegetation. A backhoe, or similar piece of equipment, digs a trench to a depth at least 36 inches below ground surface. After the trench is dug, the pipeline is assembled by welding pieces of pipe together to fit the contour of the pipeline's path. Once inspected, the pipe can be lowered into the trench and covered with stockpiled subsoil originally removed from the trench. Each pipeline undergoes hydrostatic testing prior to natural gas being pumped through the pipeline. This ensures the pipeline is strong enough and absent any leaks. Table D.1 includes some of the common wastes (hazardous and nonhazardous) that are produced during construction.

Drilling Operations

When construction of the well-pad is complete, the drilling rig and associated equipment are moved on site and erected. Usually a conventional rotary drill rig is used. The drill rig must be capable of withstanding all the anticipated conditions that may be encountered while drilling. Wells may be drilled directionally, horizontally, or vertically based on the target formation. The depth of the well is entirely dependent on the target formation depth and may be several hundred feet deep to over 20,000 feet deep.

When a conventional reserve pit [17]system is used, drilling fluid or mud is circulated through the drill pipe to the bottom of the hole, through the bit, up the bore of the well, and finally to the surface. When drilling mud emerges from the hole, it enters the reserve pit where it remains until all fluids are evaporated and the solids can be buried.

A closed-loop system operates in a similar fashion except that when the drilling mud emerges from the hole, it passes through equipment used to screen and remove drill cuttings (rock chips) and sand-sized solids rather than going into a pit. When the solids have been removed, the drilling mud is placed into holding tanks, and from the tank, used again.

In either situation the drilling mud is maintained at a specific weight and viscosity to cool the bit, seal off any porous zones (thereby protecting aquifers and preventing damage to producing zone productivity), control subsurface pressure, lubricate the drill string, clean the bottom of the hole, and bring the drill cuttings to the surface. Water-based or oil-based muds can be used. This choice is dependent on the site-specific conditions.

Once a well has been drilled, completion operations begin. Well completion involves setting casing to depth and perforating the casing in target zones.

Wells are often treated during completion to improve the recovery of hydrocarbons by increasing the rate and volume of hydrocarbons moving from the natural oil and gas reservoir into the wellbore. These processes are known as well-stimulation treatments, which create new fluid passageways in the producing formation or remove blockages within existing passageways. They include fracturing, acidizing, and other mechanical and chemical treatments often used in combination. The results from different treatments are additive and complement each other.

Hydraulic Fracturing

Hydraulic fracturing is a formation stimulation practice used to create additional permeability in a producing formation, thus allowing oil and/or gas to flow more readily toward and into the wellbore.

[17] A conventional reserve pit is a lined earthen pit excavated adjacent to a well pad and is commonly used for the disposal of drilling muds and fluids in gas or oil fields (USFWS 2009).

Hydraulic fracturing can be used to overcome natural barriers, such as naturally low permeability or reduced permeability resulting from near wellbore damage, to the flow of fluids (gas or water) to the wellbore (Groundwater Protection Council 2017). The process has been a method for additional oil and gas recovery since the 1900s; however, with the advancement of technology, in both hydraulic fracturing and horizontal drilling, it is more commonly used than previous hydraulic fracturing and horizontal drilling technologies.

Hydraulic fracturing uses high pressure pumps to pump fracturing fluid into a formation at a calculated, predetermined rate and pressure to generate fractures or cracks in the target formation. For shale developments (within Mancos shale geologic formations, for example), fracture fluids are primarily water-based fluids mixed with additives that help the water to carry "proppants" into the fractures. Proppants, which may be made up of sand, walnut hulls, or other small particles, are needed to "prop" open the fractures once the pumping of fluids has stopped. Once the fracture has initiated, additional fluids are pumped into the wellbore to continue the development of the fracture and to carry the proppant deeper into the formation. The additional fluids are needed to maintain the downhole pressure necessary to accommodate the increasing length of opened fracture in the formation.

Hydraulic fracturing increases the flow rate and volume of reservoir fluids that move from the producing formation into the wellbore. The fracturing fluid is typically more than 99% water and sand, with small amounts of readily available chemical additives used to control the chemical and mechanical properties of the water and sand mixture. Because the fluid is composed mostly of water, large volumes of water are usually needed to perform hydraulic fracturing (estimates of water usage for hydraulic fracturing are provided in the BLM New Mexico Water Support Document [BLM 2019b]). However, in some cases, water is recycled or produced water is used.

The predominant fluids currently being used for fracture treatments in the shale gas plays are water-based fracturing fluids mixed with friction-reducing additives, also known as slick water (Groundwater Protection Council 2017). The number of chemical additives used in a typical fracture treatment varies depending on the conditions of the specific well that is to be fractured. A typical fracture treatment uses very low concentrations of between three and 12 additive chemicals, depending on the characteristics of the water and the shale formation being fractured. Each component serves a specific, engineered purpose, from limiting the growth of bacteria to preventing corrosion of the well casing. The make-up of fracturing fluid varies from one geologic basin or formation to another. Because the make-up of each fracturing fluid varies to meet the specific needs of each area, there is no one-size-fits-all formula for the volumes for each additive. In classifying fracture fluids and their additives, it is important to realize that service companies that provide these additives have developed a number of compounds with similar functional properties to be used for the same purpose in different well environments. The difference between additive formulations may be as small as a change in concentration of a specific compound (Groundwater Protection Council 2017).

Before operators or service companies perform a hydraulic fracturing treatment, a series of tests are performed. These tests are designed to ensure that the well, including casing and cement, well equipment, and fracturing equipment are in proper working order and would safely withstand the application of the fracture treatment pressures and pump flow rates.

Hydraulic fracturing of horizontal shale gas wells is most commonly performed in stages. Lateral lengths in horizontal wells for development may range from 1,000 feet to more than 5,000 feet. Depending on the lengths of the laterals, treatment of wells may be performed by isolating smaller portions of the lateral. The fracturing of each portion of the lateral wellbore is called a stage. Stages are fractured sequentially beginning with the section at the farthest end of the wellbore, moving up hole as each stage of the treatment is completed until the entire lateral well has been stimulated. During drilling, the BLM is on

location during the casing and cementing of the surface casing, which is often the string of casing that protects groundwater, along with other critical casing and cementing intervals. Before hydraulic fracturing takes place, all surface casing and some deeper, intermediate zones are required to be cemented from the bottom of the cased hole to the surface. The cemented well is pressure tested to ensure there are no leaks and in some cases a cement bond log is run to ensure the cement has bonded to the casing and the formation. If the fracturing of the well is considered to be a "non-routine" fracturing job for the area, the BLM would always be on-site during those operations as well as when abnormal conditions develop during the drilling or completion of a well.

Some soils and geologic formations contain low levels of radioactive material. This naturally occurring radioactive material (NORM) emits low levels of radiation, to which everyone is exposed on a daily basis. When NORM is associated with oil and natural gas production, it begins as small amounts of uranium and thorium within the rock. These elements, along with some of their decay elements, notably Radium-226 and Radium-228, can be brought to the surface in drill cuttings and produced water. Radon-222, a gaseous decay element of radium, can come to the surface along with the shale gas. When NORM is brought to the surface, it remains in the rock pieces of the drill cuttings, remains in solution with produced water, or, under certain conditions, precipitates out in scales or sludges. The radiation is weak and cannot penetrate dense materials such as the steel used in pipes and tanks. Testing is required prior to disposal of pipes, tanks, and pipe deposits per Section 19.15.35.8 of the New Mexico Administrative Code (NMAC). Radiation levels used to define "regulated NORM" in oil-field soils, equipment, sludges or other materials related to oilfield operations or processes are defined at 20.3.14.1403 NMAC. Disposal of NORM (including in produced water) is regulated per 19.15.35.9 through 19.15.35.14 NMAC and the New Mexico environmental improvement board rule, 20.3.14 NMAC. Per 20.3.14.1403 NMAC, produced water is exempt from the requirements of these regulations if it is reinjected into a Class I or Class II Underground Injection Control (UIC) well permitted by the New Mexico Oil Conservation Division (NMOCD) and/or stored or disposed of in a double, synthetically lined surface impoundment permitted by the NMOCD.

Production Operations

Production equipment used during the life of the well may include a three-phase separator-dehydrator, flowlines, a meter run, tanks for condensate, produced oil and water, and heater treater. A pumpjack may be required if the back pressure of the well is too high. Production facilities are arranged to facilitate safety and maximize reclamation opportunities. All permanent aboveground structures not subject to safety considerations are painted a standard BLM environmental color or as landowner specified.

Workovers may be performed multiple times over the life of the well. Because oil and gas production usually declines over the years, operators perform workover operations, which involve cleaning, repairing, and maintaining the well for the purposes of increasing or restoring production.

Abandonment and Reclamation

Well abandonment (whether dry hole or depleted producer) and reclamation of location, access road, and other facilities requires BLM approval. After approval, wellbores are plugged with cement as necessary to prevent fluid or pressure mitigation and to protect and isolate mineral and water resources. Wellheads are removed, and both the surface casing and the production casing are cut off below ground in compliance with federal and state regulations. The well pad, reserve pit and access are reclaimed according to BLM guidelines. This may include backfilling the pit, recontouring the surface to blend with natural surroundings and redistributing topsoil. All surfaces are then reseeded per BLM and State requirements specified in the Application for Permit to Drill (APD) approval.

Common Wastes

Table D.1 includes some of the common wastes (hazardous and nonhazardous) that are produced during oil and gas development.

Table D.1. Common Wastes Produced during Oil and Gas Development

Phase	Waste	
Construction, Well Drilling and Completion (including hydraulic fracturing)	Domestic wastes (i.e., food scraps, paper, etc.)	
	Excess construction materials	Woody debris
	Used lubricating oils	Paints
	Solvents	Sewage
	Drilling muds, including additives (i.e., chromate and barite) and cuttings; Well drilling, completion, workover, and stimulation fluids (i.e., oil derivatives such as polycyclic aromatic hydrocarbons (PAHs), spilled chemicals, suspended and dissolved solids, phenols, cadmium, chromium, copper, lead, mercury, nickel)	
	Equipment, power unit and transport maintenance wastes (i.e., batteries; used filters, lubricants, oil, tires, hoses, hydraulic fluids; paints; solvents)	
	Fuel and chemical storage drums and containers	
	Cementing wastes	Rig wash
	Production testing wastes	Excess drilling chemicals
	Excess construction materials	Processed water
	Scrap metal	Contaminated soil including hazardous and non-hazardous materials (potential)
	Sewage	Domestic wastes
Production	Power unit and transport maintenance wastes (i.e., batteries; used filters, lubricants, filters, tires, hoses, coolants, antifreeze; paints; solvents, used parts)	
	Discharged produced water	
	Production chemicals	
	Workover wastes (e.g., brines)	
Abandonment / Reclamation	Construction materials	
	Decommissioned equipment	
	Contaminated soil (potential)	
	Equipment or wastes that could contain hazardous and nonhazardous materials	

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APPENDIX E. SOCIAL COST OF CARBON

A protocol to estimate what is referenced as the "social cost of carbon" (SCC) associated with greenhouse gas (GHG) emissions was developed by a federal Interagency Working Group (IWG), to assist agencies in addressing Executive Order 12866, which requires federal agencies to assess the cost and the benefits of proposed regulations as part of their regulatory impact analyses. The SCC is an estimate of the economic damages associated with an increase in carbon dioxide emissions and is intended to be used as part of a cost-benefit analysis for proposed rules. As explained in the Executive Summary of the 2010 SCC Technical Support Document "the purpose of the [SCC] estimates…is to allow agencies to incorporate the social benefits of reducing carbon dioxide (CO2) emissions into cost-benefit analyses of regulatory actions that have small, or 'marginal,' impacts on cumulative global emissions" (IWG 2010; withdrawn by Executive Order 13783). While the SCC protocol was created to meet the requirements for regulatory impact analyses during rulemakings, there have been requests by public commenters or project applicants to expand the use of SCC estimates to project-level National Environmental Policy Act (NEPA) analyses.

The decision was made not to expand the use of the SCC protocol for the lease sale NEPA analysis for a number of reasons. Most notably, this action is not a rulemaking for which the SCC protocol was originally developed. Second, on March 28, 2017, the President issued Executive Order 13783 which, among other actions, withdrew the Technical Support Documents upon which the protocol was based and disbanded the earlier IWG on Social Cost of Greenhouse Gases. The Executive Order further directed agencies to ensure that estimates of the social cost of greenhouse gases used in regulatory analyses "are based on the best available science and economics" and are consistent with the guidance contained in Office of Management and Budget (OMB) Circular A-4, "including with respect to the consideration of domestic versus international impacts and the consideration of appropriate discount rates" (Executive Order 13783, Section 5(c)). In compliance with OMB Circular A-4, interim protocols have been developed for use in the rulemaking context. However, the Circular does not apply to project decisions, so there is no Executive Order requirement to apply the SCC protocol to project decisions.

Further, NEPA does not require a cost-benefit analysis (40 CFR 1502.23), although NEPA does require consideration of "effects" that include "economic" and "social" effects (40 CFR 1508.8(b)). Without a complete monetary cost-benefit analysis, which would include the social benefits of the Proposed Action to society as a whole and other potential positive benefits, inclusion solely of an SCC cost analysis would be unbalanced, potentially inaccurate, and not useful in facilitating an authorized officer's decision. Any increased economic activity, in terms of revenue, employment, labor income, total value added, and output, that is expected to occur with the Proposed Action is simply an economic impact, rather than an economic benefit, inasmuch as such impacts might be viewed by another person as negative or undesirable impacts due to potential increase in local population, competition for jobs, and concerns that changes in population will change the quality of the local community. Economic impact is distinct from "economic benefit" as defined in economic theory and methodology, and the socioeconomic impact analysis required under NEPA is distinct from cost-benefit analysis, which is not required.

Finally, the SCC protocol does not measure the actual incremental impacts of a project on the environment and does not include all damages or benefits from carbon emissions. The SCC protocol estimates economic damages associated with an increase in carbon dioxide emissions—typically expressed as a 1 metric ton increase in a single year—and includes, but is not limited to, potential changes in net agricultural productivity, human health, and property damages from increased flood risk over hundreds of years. The estimate is developed by aggregating results "across models, over time, across regions and impact categories, and across 150,000 scenarios" (Rose et al. 2014). The dollar cost figure arrived at based on the SCC calculation represents the value of damages avoided if, ultimately, there is no increase in carbon emissions. But the dollar cost figure is generated in a range and provides little benefit

in assisting the authorized officer's decision for project-level analyses. For example, in a recent environmental impact statement, the Office of Surface Mining estimated that the selected alternative had a cumulative SCC ranging from approximately $4.2 billion to $22.1 billion depending on dollar value and the discount rate used. The cumulative SCC for the No Action Alternative ranged from $2.0 billion to $10.7 billion. Given the uncertainties associated with assigning a specific and accurate SCC resulting from oil and gas production that could occur once the oil and gas lease is issued, and that the SCC protocol and similar models were developed to estimate impacts of regulations over long time frames, this EA quantifies direct and indirect GHG emissions and evaluates these emissions in the context of U.S. and State/County GHG emission inventories as discussed in the Affected Environment and Environmental Impacts section of the EA. This approach quantifies the relative magnitude of the Proposed Action emissions and discloses the incremental contribution of the Proposed Action towards climate change impacts. The cumulative analysis uses the same approach to quantify the relative magnitude of reasonably foreseeable BLM NMSO leasing activity emissions. To relate this information to the bigger picture of BLM contributions to GHG emissions and the implications for climate change, projected BLM lease sale emission trends are compared against three Representative Concentration Pathway (RCP) scenario emission profiles: stringent mitigation – RCP 2.6, moderate mitigation – RCP 4.5, and no mitigation - RCP 8.5. Further, RCP scenario climate model annual average global temperatures are shown for context to demonstrate how the two different GHG emission mitigation scenarios (RCP 2.6 and RCP 4.5) compare with the "no mitigation" scenario (RCP 8.5). Finally, a summary discussion of the effects of GHG projected at the global and regional scale based on an appropriate literature review is included. Comparing the relative magnitude of the Proposed Action emissions and BLM NMSO reasonably foreseeable development emissions to state, national, and global emissions, as appropriate, then providing a qualitative summary discussion of the effects of GHG emissions presents potential environmental impacts in clear terms and provides sufficient information to make a reasoned choice between alternatives.

To summarize, this EA does not undertake an analysis of SCC because 1) it is not engaged in a rulemaking for which the protocol was originally developed; 2) the IWG, technical supporting documents, and associated guidance have been withdrawn; 3) NEPA does not require cost-benefit analysis; and 4) the full social benefits of oil and gas production have not been monetized, and quantifying only the costs of GHG emissions but not the benefits would yield information that is both potentially inaccurate and not useful.

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