

**DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
CARLSBAD FIELD OFFICE**

**Project: July 2016 Competitive Oil and Gas Lease Sale
EA Log Number: DOI-BLM-NM-P020-2016-0588-EA
Location: Various Locations in Eddy and Lea County, New Mexico**

Finding of No Significant Impact

Based on the analysis of potential environmental impacts contained in the attached Environmental Assessment (EA), I have determined the Proposed Action is not expected to have significant impacts on the environment. The impacts of leasing the fluid minerals estate in the areas described with this EA have been previously analyzed in the Carlsbad Resource Management Plan and Final Environmental Impact Statement (BLM 1988); the Carlsbad Resource Management Plan Amendment and Final Environmental Impact Statement for Oil and Gas Resources (BLM 1997); and the Roswell Resource Area Resource Management Plan and Final Environmental Impact Statement (BLM 1997). The Records of Decision for these plans were approved in the year indicated. The Special Status Species RMPA Record of Decision, signed in 2008, amends these plans in portions of Chaves, Eddy, Lea and Roosevelt Counties, New Mexico, with reference to Planning Areas as described in that document. The lease stipulations that accompany the tracts proposed for leasing would mitigate the impacts of future development on these tracts. Therefore, preparation of an Environmental Impact Statement is not warranted.

Prepared by:

Todd Bowen, Planning and Environmental Coordinator

Date_____

Reviewed By:

James Stovall, District Manager

Date_____

Approved by:

Amy Lueders, State Director

Date_____

**ENVIRONMENTAL ASSESSMENT FOR
JULY 2016 COMPETITIVE OIL AND GAS LEASE SALE
CARLSBAD FIELD OFFICE
DOI-BLM-NM-P020-2016-0588-EA**

INTRODUCTION

It is the policy of the Bureau of Land Management (BLM) as derived from various laws, including the Mineral Leasing Act of 1920 (MLA), as amended [30 U.S.C. 181 *et seq.*], and the Federal Land Policy and Management Act of 1976 (FLPMA), as amended, to make mineral resources available for disposal and to manage for multiple resources which include the development of mineral resources to meet national, regional, and local needs.

The BLM New Mexico State Office (NMSO) conducts a quarterly competitive lease sale to offer available oil and gas lease parcels in New Mexico, Oklahoma, Texas, and Kansas. A Notice of Competitive Lease Sale (NCLS), which lists lease parcels to be offered at the auction, is published by the NMSO at least 90 days before the auction is held. Lease stipulations applicable to each parcel are specified in the Sale Notice. The decision as to which public lands and minerals are open for leasing and what leasing stipulations are necessary, based on information available at the time, is made during the land use planning process. Surface management of non-BLM administered land overlaying federal minerals is determined by the BLM in consultation with the appropriate surface management agency or the private surface owner.

In the process of preparing a lease sale the NMSO sends a draft parcel list to any BLM field offices in which parcels are located. Field office staff then review the legal descriptions of the parcels to determine if they are in areas open to leasing; if new information has become available which might change any analysis conducted during the planning process; if appropriate consultations have been conducted; what appropriate stipulations should be included; and if there are special resource conditions of which potential bidders should be made aware. The parcels nominated for this sale, along with the appropriate stipulations from the appropriate land use plans and subsequent amendments, are posted online for a two week public scoping period. Comments received are reviewed and incorporated into the Environmental Assessment (EA).

Once the draft parcel review is completed and returned to the NMSO, a list of nominated lease parcels with specific, applicable stipulations is made available through the NCLS. On rare occasions, additional information obtained after the publication of the NCLS may result in deferral of certain parcels prior to the lease sale.

This EA documents the BLM Carlsbad Field Office (CFO) review of the 36 parcels nominated for the July 2016 Competitive Oil and Gas Lease Sale that are under the administration of the CFO. It serves to verify conformance with the approved land use plan, provides the rationale for deferring or dropping parcels from a lease sale, as well as providing rationale for attaching lease stipulations to specific parcels.

The parcels and applicable stipulations were posted online for a two week public scoping period starting on December 14, 2015. In addition, this EA was made available for public review and

comment for 30 days beginning February 8, 2016. Any comments provided prior to the lease sale will be considered and incorporated into the EA as appropriate. See Section 6.1 of this EA for more information on the comments received.

Purpose and Need

The purpose is to consider opportunities for private individuals or companies to explore for and develop oil and gas resources on public lands through a competitive leasing process.

The need of the action is established by the BLM's responsibility under the MLA, as amended, to promote the development of oil and gas on the public domain. The MLA also 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 the Federal Land Policy and Management Act (FLPMA), the National Environmental Policy Act (NEPA) of 1969, as amended (Public Law 91-90, 42 USC 4321 et seq.), and other applicable laws, regulations, and policies.

The BLM will decide whether or not to lease the nominated parcels and, if so, under what terms and conditions.

1.1 Conformance with Applicable Land Use Plan and Other Environmental Assessments

The applicable land use plans for this action are the Carlsbad Resource Management Plan and Final Environmental Impact Statement (1988); the Carlsbad Resource Management Plan Amendment and Final Environmental Impact Statement for Oil and Gas Resources (1997); and the Roswell Resource Management Plan and Final Environmental Impact Statement (1997). The Records of Decision for these plans were approved in the year indicated. The Special Status Species RMPA Record of Decision, signed in 2008, amends these plans in portions of Chaves, Eddy, Lea, and Roosevelt Counties, New Mexico, with reference to Planning Areas as described in that document. These land use plans designate approximately 12.87 million acres of federal minerals as available for leasing. These land use plans also describe specific stipulations that would be attached to new leases offered in certain areas. Therefore, it is determined that the alternatives considered conform to fluid mineral leasing decisions in these land use plans and subsequent amendments are consistent with the goals and objectives for natural and cultural resources.

The CFO Resource Management Plan is currently undergoing a revision with a draft EIS anticipated in mid 2016. The EIS is analyzing four action alternatives, of which one will be selected as the preferred, that will guide the agency in making new management decisions for all the resources and resource uses under the BLM's authority to manage. Guidance found in BLM's Land Use Planning Handbook (H-1601-1) directs the agency to carefully consider approving ongoing actions that may limit the choice of reasonable alternatives being considered in the RMP EIS. For oil and gas leasing, the new RMP will allocate areas within the planning area that will either be closed, open, open subject to major constraints, or open subject to minor constraints. In BLM's preliminary analysis, it was determined that leasing the nominated parcels would not limit the choice of reasonable alternatives being considered in the draft EIS.

Pursuant to 40 Code of Federal Regulations (CFR) 1508.28 and 1502.21, this EA is tiered to and incorporates by reference the information and analysis contained in the RMP and RMPAs and their Final Environmental Impact Statements. While it is unknown precisely when, where, or to what extent well sites or roads would be proposed, the analysis of projected surface disturbance impacts, should a lease be developed, is based on well spacing requirements at each parcel location. While an appropriate level of site-specific analysis of individual wells or roads would occur when a lease holder submits an Application for Permit to Drill (APD), assumptions based on the full lease development will be used in the analysis of impacts in this EA.

Federal Land Policy and Management Act (FLPMA) of 1976 established guidelines to provide for the management, protection, development, and enhancement of public lands (Public Law 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 U.S., 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 in the RMP, including identification of all appropriate lease stipulations (43 CFR 3101.1 and 43 CFR 1601.0-7(b); BLM Manual Handbook 1601.09 and 1624-1).

1.2 Federal, State or Local Permits, Licenses or Other Consultation Requirements

Purchasers of oil and gas leases are required to comply with all applicable federal, state, and local laws and regulations, including obtaining all necessary permits required should lease development occur.

Endangered Species Act of 1973

Effects of oil and gas leasing and development on threatened or endangered species were analyzed in Section 7 consultation for the 1997 RFO RMP and CFO RMPA (Cons. # 2-22-96-F-128). In April 2008, the BLM Pecos District Special Status Species RMPA amended both these land use plans in portions of Chaves, Eddy Lea and Roosevelt Countie, as described in that document, to ensure continued habitat protection of two special status species, the lesser prairie-chicken (*Tympanuchus pallidicinctus*)(LPC) and the dunes sagebrush lizard (*Sceloporus arenicolus*)(DSL). This action is 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 FLMPA of 1976 and the NEPA of 1969.

On March 27, 2014, the US Fish & Wildlife Service (USFWS) published in the Federal Register the final rule to list the lesser prairie-chicken as threatened under the Endangered Species Act (ESA). The BLM entered into Section 7 consultation regarding its leasing program and subsequent development. Any lease parcel that may be affected by the Section 7 consultation will not be leased until consultation with the USFWS has been completed.

Federal regulations and policies require the BLM to make its public land and resources available on the basis of the principle of multiple-use. At the same time, 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.

National Historic Preservation Act

Compliance with Section 106 responsibilities of the National Historic Preservation Act (NHPA) are adhered to by following the Protocol Agreement between New Mexico BLM and New Mexico State Historic Preservation Officer (Protocol Agreement), which is authorized by the National Programmatic Agreement between BLM, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers, and other applicable BLM handbooks. Compliance with BLM Instructional Memorandums NM-2004-035 (Consultations with Indian Tribes Regarding Traditional Cultural Properties and Sacred Sites in the Fluid Minerals Program), Instructional Memorandum WO-2012-061 (Revised Programmatic Agreement Regarding the Manner in which the Bureau of Land Management will meet its Responsibilities under the National Historic Preservation Act), and Instructional Memorandum WO-2012-062 (Implementation of the Department of Interior Tribal Consultation Policy) are adhered to by providing interested Native American tribes with parcel information and maps.

Native American consultation is conducted by certified mail regarding each lease sale activity. If Traditional Cultural Properties (TCP) or heritage-related issues are identified, such parcels are withheld from the sale while letters requesting information, comments, or concerns are sent to the Native American representative. If the same draft parcels appear in a future sale, a second request for information is sent to the same recipients and the parcels will be held back again. If no response to the second letter is received, the parcels are allowed to be offered in the next sale.

If responses are received, BLM cultural resources staff will discuss the information or issues of concern with the Native American representative to determine if all or portions of a parcel need to be withdrawn from the sale, or if special stipulations need to be attached as lease stipulations.

1.3 Identification of Issues

The July 2016 parcel list was received by the CFO on November 9, 2015. The interdisciplinary team (IDT) in the CFO reviewed the parcels to identify and consider potentially affected resources as well as associated issues. The parcels were also reviewed for conformance with the land use plans, and lease stipulations were attached to the parcels recommended for leasing.

The proposed parcels along with the appropriate stipulations were posted online at http://www.blm.gov/nm/st/en/prog/energy/oil_and_gas/oil_and_gas_lease/2016_lease_sale_nominated/july_2016_lease_sale.html for a two week scoping period from December 14, 2015 through December 30, 2015. One external scoping comment letter from the Center for Biological Diversity was received. Issues raised in the letter included the dangers of hydraulic fracking and horizontal drilling, risks to water resources, risks to air quality, climate change, impacts to sensitive species and wildlife, seismic risks, human health and safety risks, and land use. The commenter asked that the BLM either cease all new leasing, defer the July 2016 lease sale until a Resource Management Plan revision has been completed, or prepare a full EIS in consultation with the USFWS.

This EA was made available for public review and comment for 30 days beginning on February 8, 2016.

Based on these scoping efforts, the following issues have been determined relevant to the analysis of this action:

- *What effect will the proposed action have on air quality of southeastern New Mexico?*
- *What effect will the proposed action have on global climate change?*
- *What effect will the proposed action have on wetlands and riparian areas?*
- *What effect will the proposed action have on vegetation and forage for grazing and wildlife?*
- *What effect will the proposed action have on spreading of noxious weeds?*
- *What effect will the proposed action have on raptors or their nests?*
- *What effect will the proposed action have on environmental justice?*
- *What effect will the proposed action have on recreation opportunities?*
- *What effect will the proposed action have on significant cave and karst resources?*
- *What effect will the proposed action have on known heritage resources eligible for listing on the National Register of Historic Places?*
- *What effect will the proposed action have on known paleontological resources?*
- *What effect will the proposed action have on slopes or fragile soils?*
- *What effect will the proposed action have on playas or alkali lakes?*
- *What effect will the proposed action have on potash resources?*
- *What effect will the proposed action have on the water resources?*
- *What effect will the proposed action have on lesser prairie-chickens and their habitat?*
- *What effect will the proposed action have on dune sagebrush lizards and their habitat?*
- *What effect will the proposed action have on wildlife habitat projects with the parcel?*
- *What effect will the proposed action have on visual resource management?*

The following elements are not present as determined by the IDTs: Prime or Unique Farmlands, Wild and Scenic Rivers, Wilderness or Wilderness Study Areas, and Wild Horses and Burros.

PROPOSED ACTION AND ALTERNATIVES

2.0 Alternatives Including the Proposed Action

2.1 Alternative A – No Action

The BLM NEPA Handbook (H-1790-1) states that for EAs on externally initiated proposed actions, the No Action Alternative generally means that the proposed action would not take place. In the case of a lease sale, this would mean that an expression of interest to lease (parcel nomination) would be deferred, and the 36 parcels totaling 13,876.08 acres would not be offered for lease during the July 2016 Competitive Oil and Gas Lease Sale. Surface management and any ongoing oil and gas development on surrounding federal, private, and state leases would continue under current guidelines and practices. Selection of the No Action Alternative would not preclude these parcels from being nominated and considered in a future lease sale.

2.2 Alternative B – Proposed Action

The Proposed Action is to lease 36 parcels of federal minerals nominated by the public that are in conformance with the land use plans and amendments, covering approximately 13,876.08 acres administered by the CFO, for oil and gas exploration and development. Standard terms and conditions as well as stipulations listed in the RMP and RMPAs would apply.

The lease purchaser would have the exclusive right to use as much of the leased lands as would be necessary to explore and drill for oil and gas (see Appendix 2: Phases of Oil and Gas Development) within the lease boundaries, subject to: stipulations attached to the lease; restrictions deriving from specific, nondiscretionary statutes; and such reasonable measures as may be required by the authorized officer to minimize adverse impacts to other resource values, land uses or users not addressed in the lease stipulations at the time operations are proposed (43 CFR 3101). Oil and gas leases are issued for a 10-year period and continue for as long thereafter as oil or gas is produced in paying quantities. If a lease holder fails to produce oil and gas, does not make annual rental payments, does not comply with the terms and conditions of the lease, or relinquishes the lease, exclusive right to develop the leasehold reverts back to the federal government and the lease can be reoffered in another lease sale.

Drilling of wells on a lease would not be permitted until the lease owner or operator meets the site specific requirements specified in 43 CFR 3162. An APD would not be authorized until site-specific NEPA analysis is conducted.

In addition to the above, lease notices and lease stipulation can be attached to proposed parcels. Lease notices serve to inform the prospective lease holder of certain conditions occurring within the parcel. Lease stipulations are requirements that must be met before an APD can be approved. Lease notices and lease stipulations are described in Appendix 1 of this document. Table 1 describes the nominated lease parcels and stipulations that are in conformance with the applicable land use plan and amendments.

Table 1. Proposed Action Lease Parcel List

Parcel	Comments	Acres
NM-201607-001 T.0160S, R.0270E, 23 PM, NM Sec. 003 LOTS 1-16; 003 S2	<u>Lease with the following stipulations:</u> SENM-S-17 CSU – Slopes and Fragile Soils SENM-S-21 CSU – Caves and Karst NM-LN-11 Special Cultural Resource SENM-LN-1 Lease Notice – Cave-Karst Occurrence Area	871.840
NM-201607-002 T.0240S, R.0280E, 23 PM, NM Sec. 006 LOTS 2,3	<u>Lease with the following stipulations:</u> SENM-S-21 CSU – Caves and Karst NM-LN-11 Special Cultural Resource SENM-LN-1 Lease Notice – Cave-Karst Occurrence Area	79.920

Parcel	Comments	Acres
NM-201607-003 T.0230S, R.0290E, 23 PM, NM Sec. 028 E2E2	<u>Lease with the following stipulations:</u> SENM-S-1 Potash SENM-S-18 Floodplains SENM-S-19 Playas SENM-S-21 CSU – Caves and Karst NM-LN-11 Special Cultural Resource SENM-LN-1 Lease Notice – Cave-Karst Occurrence Area SENM-LN-6 Lease Notice Oil and Gas Development Within the Designated Potash Area	160.000
NM-201607-004 T.0240S, R.0290E, 23 PM, NM Sec. 018 NENW	<u>Lease with the following stipulations:</u> SENM-S-17 CSU - Slopes and Fragile Soils SENM-S-18 Floodplains SENM-S-21 CSU – Caves and Karst SENM-S-25 VRM – Visual Resource Management SENM-S-43 NSO – Pecos River Corridor SRMA NM-LN-11 Special Cultural Resource SENM-LN-1 Lease Notice – Cave-Karst Occurrence Area	40.000
NM-201607-005 T.0240S, R.0290E, 23 PM, NM Sec. 018 LOTS 4	<u>Lease with the following stipulations:</u> SENM-S-17 CSU - Slopes and Fragile Soils SENM-S-18 Floodplains SENM-S-21 CSU – Caves and Karst SENM-S-25 VRM – Visual Resource Management NM-LN-11 Special Cultural Resource SENM-LN-1 Lease Notice – Cave-Karst Occurrence Area	39.840
NM-201607-006 T.0240S, R.0300E, 23 PM, NM Sec. 013 SESE	<u>Lease with the following stipulations:</u> SENM-S-1 Potash SENM-S-22 CSU – Prairie Chickens SENM-S-34 POD/Shinery Oak Sand Dune Habitat NM-LN-11 Special Cultural Resource SENM-LN-6 Lease Notice Oil and Gas Development Within the Designated Potash Area	40.000
NM-201607-007 T.0200S, R.0320E, 23 PM, NM Sec. 008 SESE	<u>Lease with the following stipulations:</u> SENM-S-1 Potash SENM-S-22 CSU – Prairie Chickens SENM-S-23 CSU – Sand Dune Lizard SENM-S-34 POD/Shinery Oak Sand Dune Habitat SENM-S-46 Sand Dune Lizard Survey Requirements & Plan of Development NM-LN-11 Special Cultural Resource SENM-LN-6 Lease Notice Oil and Gas Development Within the Designated Potash Area Note: Located on top of potash mine workings	40.000

Parcel	Comments	Acres
NM-201607-008 T.0230S, R.0320E, 23 PM, NM Sec. 024 NW	<u>Lease with the following stipulations:</u> SENM-S-22 CSU – Prairie Chickens SENM-S-34 POD/Shinery Oak Sand Dune Habitat NM-LN-11 Special Cultural Resource NOTE: Not in Secretary's Potash but located over planned ICP Mine location.	160.000
NM-201607-009 T.0230S, R.0320E, 23 PM, NM Sec. 035 W2	<u>Lease with the following stipulations:</u> SENM-S-22 CSU – Prairie Chickens SENM-S-34 POD/Shinery Oak Sand Dune Habitat SENM-S-47 Lease Reclamation NM-LN-11 Special Cultural Resource	320.000
NM-201607-010 T.0200S, R.0330E, 23 PM, NM Sec. 028 S2SW,SWSE	<u>Lease with the following stipulations:</u> SENM-S-1 Potash SENM-S-17 CSU – Slopes and Fragile Soils SENM-S-22 CSU – Prairie Chickens SENM-S-34 POD/Shinery Oak Sand Dune Habitat NM-LN-11 Special Cultural Resource SENM-LN-6 Lease Notice Oil and Gas Development Within the Designated Potash Area	120.000
NM-201607-011 T.0260S, R.0330E, 23 PM, NM Sec. 030 N2NE,NENW	<u>Lease with the following stipulations:</u> SENM-S-21 CSU – Caves and Karst SENM-S-34 POD/Shinery Oak Sand Dune Habitat NM-LN-11 Special Cultural Resource SENM-LN-1 Lease Notice – Cave-Karst Occurrence Area	120.000
NM-201607-012 T.0220S, R.0340E, 23 PM, NM Sec. 035 N2SW,NWSE	<u>Lease with the following stipulations:</u> SENM-S-17 CSU – Slopes and Fragile Soils SENM-S-22 CSU – Prairie Chickens SENM-S-34 POD/Shinery Oak Sand Dune Habitat NM-LN-11 Special Cultural Resource	120.000
NM-201607-013 T.0250S, R.0340E, 23 PM, NM Sec. 014 SW	<u>Lease with the following stipulations:</u> SENM-S-22 CSU – Prairie Chickens SENM-S-34 POD/Shinery Oak Sand Dune Habitat NM-LN-11 Special Cultural Resource	160.000
NM-201607-014 T.0250S, R.0340E, 23 PM, NM Sec. 021 NENE	<u>Lease with the following stipulations:</u> SENM-S-22 CSU – Prairie Chickens SENM-S-34 POD/Shinery Oak Sand Dune Habitat NM-LN-11 Special Cultural Resource	40.000

Parcel	Comments	Acres
NM-201607-015 T.0250S, R.0340E, 23 PM, NM Sec. 024 NENE,S2NE,S2; 025 ALL T.0250S, R.0350E, 23 PM, NM Sec. 030 NE,E2NW,NESW; 019 LOTS 1-4; 019 E2,E2W2; 030 LOTS 1-4	<u>Lease with the following stipulations:</u> SENM-S-17 CSU – Slopes and Fragile Soils SENM-S-22 CSU – Prairie Chickens SENM-S-34 POD/Shinery Oak Sand Dune Habitat NM-LN-11 Special Cultural Resource	2,160.080
NM-201607-016 T.0250S, R.0340E, 23 PM, NM Sec. 035 S2N2	<u>Lease with the following stipulations:</u> SENM-S-22 CSU – Prairie Chickens SENM-S-34 POD/Shinery Oak Sand Dune Habitat NM-LN-11 Special Cultural Resource	160.000
NM-201607-017 T.0200S, R.0350E, 23 PM, NM Sec. 014 N2NW,SWNW,SW	<u>Lease with the following stipulations:</u> SENM-S-17 CSU – Slopes and Fragile Soils SENM-S-22 CSU – Prairie Chickens SENM-S-23 CSU – Sand Dune Lizard SENM-S-34 POD/Shinery Oak Sand Dune Habitat SENM-S-46 Sand Dune Lizard Survey Requirements & Plan of Development NM-LN-11 Special Cultural Resource	280.000
NM-201607-018 T.0250S, R.0350E, 23 PM, NM Sec. 017 S2; 018 LOTS 1-4; 018 E2W2,SE	<u>Lease with the following stipulations:</u> SENM-S-22 CSU – Prairie Chickens SENM-S-34 POD/Shinery Oak Sand Dune Habitat NM-LN-11 Special Cultural Resource	799.200
NM-201607-019 T.0260S, R.0350E, 23 PM, NM Sec. 009 NENE	<u>Lease with the following stipulations:</u> SENM-S-22 CSU – Prairie Chickens SENM-S-34 POD/Shinery Oak Sand Dune Habitat NM-LN-11 Special Cultural Resource	40.000
NM-201607-020 T.0260S, R.0350E, 23 PM, NM Sec. 009 NW	<u>Lease with the following stipulations:</u> SENM-S-22 CSU – Prairie Chickens SENM-S-34 POD/Shinery Oak Sand Dune Habitat NM-LN-11 Special Cultural Resource	160.000
NM-201607-021 T.0260S, R.0350E, 23 PM, NM Sec. 021 SENE,E2SE	<u>Lease with the following stipulations:</u> SENM-S-22 CSU – Prairie Chickens SENM-S-34 POD/Shinery Oak Sand Dune Habitat NM-LN-11 Special Cultural Resource NOTE: The successful bidder will be required to join the Arena Roja Federal Unit, NMNM 112744X, prior to lease issuance. Operator: Devon Energy Production Co., LP	120.000

Parcel	Comments	Acres
NM-201607-022 T.0250S, R.0360E, 23 PM, NM Sec. 003 LOTS 3,4; 003 S2NW,SW; 004 LOTS 1,2; 004 S2NE	<u>Lease with the following stipulations:</u> SENM-S-18 Floodplains SENM-S-34 POD/Shinery Oak Sand Dune Habitat NM-LN-11 Special Cultural Resource	481.240
NM-201607-023 T.0250S, R.0360E, 23 PM, NM Sec. 015 ALL; 022 E2	<u>Lease with the following stipulations:</u> SENM-S-18 Floodplains SENM-S-34 POD/Shinery Oak Sand Dune Habitat NM-LN-11 Special Cultural Resource	960.000
NM-201607-024 T.0250S, R.0360E, 23 PM, NM Sec. 027 ALL	<u>Lease with the following stipulations:</u> SENM-S-34 POD/Shinery Oak Sand Dune Habitat NM-LN-11 Special Cultural Resource	640.000
NM-201607-025 T.0250S, R.0360E, 23 PM, NM Sec. 033 ALL; 034 ALL	<u>Lease with the following stipulations:</u> SENM-S-18 Floodplains SENM-S-34 POD/Shinery Oak Sand Dune Habitat NM-LN-11 Special Cultural Resource	1,280.000
NM-201607-026 T.0260S, R.0360E, 23 PM, NM Sec. 003 NE,S2; 010 N2,NESE	<u>Lease with the following stipulations:</u> SENM-S-17 CSU – Slopes and Fragile Soils SENM-S-34 POD/Shinery Oak Sand Dune Habitat NM-LN-11 Special Cultural Resource	840.000
NM-201607-027 T.0260S, R.0360E, 23 PM, NM Sec. 004 E2,E2W2,NWSW; 009 N2	<u>Lease with the following stipulations:</u> SENM-S-17 CSU – Slopes and Fragile Soils SENM-S-18 Floodplains SENM-S-34 POD/Shinery Oak Sand Dune Habitat NM-LN-11 Special Cultural Resource	840.000
NM-201607-028 T.0220S, R.0380E, 23 PM, NM Sec. 005 LOTS 1-4; 005 S2N2,SE	<u>Lease with the following stipulations:</u> SENM-S-17 CSU – Slopes and Fragile Soils SENM-S-18 Floodplains SENM-S-22 CSU – Prairie Chickens SENM-S-34 POD/Shinery Oak Sand Dune Habitat NM-LN-11 Special Cultural Resource	480.840
NM-201607-029 T.0220S, R.0380E, 23 PM, NM Sec. 007 NENE	<u>Lease with the following stipulations:</u> SENM-S-17 CSU – Slopes and Fragile Soils NM-LN-11 Special Cultural Resource	40.000
NM-201607-030 T.0220S, R.0380E, 23 PM, NM Sec. 033 LOTS 4; T.0230S, R.0380E, 23 PM, NM Sec. 004 LOTS 2; 004 SENW,SW; 009 N2NW	<u>Lease with the following stipulations:</u> SENM-S-17 CSU – Slopes and Fragile Soils SENM-S-18 Floodplains SENM-S-22 CSU – Prairie Chickens SENM-S-34 POD/Shinery Oak Sand Dune Habitat NM-LN-11 Special Cultural Resource	371.200

Parcel	Comments	Acres
NM-201607-031 T.0230S, R.0380E, 23 PM, NM Sec. 005 SESW; 007 S2SE; 008 NWNE,W2,SE; 009 SW; 017 E2NE	<u>Lease with the following stipulations:</u> SENM-S-18 Floodplains SENM-S-19 Playas SENM-S-39 POD – Plan of Development Stipulation NM-LN-11 Special Cultural Resource	880.000
NM-201607-032 T.0230S, R.0380E, 23 PM, NM Sec. 006 NWSE	<u>Lease with the following stipulations:</u> NM-LN-11 Special Cultural Resource	40.000
NM-201607-033 T.0230S, R.0380E, 23 PM, NM Sec. 006 SWSW; 007 N2NW	<u>Lease with the following stipulations:</u> SENM-S-18 Floodplains NM-LN-11 Special Cultural Resource	120.000
NM-201607-034 T.0230S, R.0380E, 23 PM, NM Sec. 007 W2SW	<u>Lease with the following stipulations:</u> SENM-S-18 Floodplains NM-LN-11 Special Cultural Resource	80.000
NM-201607-035 T.0260S, R.0380E, 23 PM, NM Sec. 021 LOTS 1-4; 021 NW,S2SW	<u>Lease with the following stipulations:</u> SENM-S-17 CSU – Slopes and Fragile Soils SENM-S-18 Floodplains SENM-S-34 POD/Shinery Oak Sand Dune Habitat NM-LN-11 Special Cultural Resource	275.800
NM-201607-036 T.0260S, R.0380E, 23 PM, NM Sec. 028 LOTS 1-4; 028 W2 Sec. 033 LOTS 1-4 033 N2NW	<u>Lease with the following stipulations:</u> SENM-S-17 CSU – Slopes and Fragile Soils SENM-S-18 Floodplains SENM-S-34 POD/Shinery Oak Sand Dune Habitat NM-LN-11 Special Cultural Resource	516.120
	Total Acres	13,876.080

2.3 Reasonably Foreseeable Development under Alternative B

At the leasing stage, it is uncertain if an APD on leased parcels would be received, nor is it known if or to what extent development would occur. Such development may include constructing a well pad and access road, drilling a well using a conventional pit system or closed-loop system, hydraulically fracturing the well, installing pipelines and/or hauling produced fluids, regularly monitoring the well, and completing work-over tasks throughout the life of the well. In the CFO, typically, all of these actions are undertaken during development of an oil or gas well; it is reasonably foreseeable that they may occur on leased parcels. See Appendix 2 for a complete description of the phases of oil and gas development.

Drilling of wells on a lease would not be permitted until the lease owner or operator secures approval of a drilling permit and a surface use plan as specified under Onshore Oil and Gas Orders (43 CFR 3162). An APD would not be authorized until site-specific NEPA analysis is conducted.

Standard terms and conditions, stipulations listed in the CFO RMP, and any new stipulations would apply as appropriate to each lease. In addition, site specific mitigation measures and best management practices (BMPs) would be attached as Conditions of Approval (COAs) for each proposed exploration and development activity authorized on a lease.

2.3.1 Surface Disturbance Assumptions

Assumptions of total surface disturbance is based on estimating the maximum potential that could be developed within the nominated lease parcel relative to past development knowledge and practices and resource concerns within the parcels. Exploration and development of hydrocarbon resources outside of well-developed areas increases the distance required for roads, pipelines, and power lines.

The surface disturbance assumptions shown in the following tables estimate impacts associated with oil and gas exploration and development drilling activities that could occur at each lease parcel if it were fully developed. The CFO randomly sampled 70 new wells that had been drilled within the last four years to determine surface disturbance created during oil and gas exploration. The average length of new road required to drill a new well based on our random sample is 570 feet. The average surface disturbance of an oil or gas well pad is 300 feet by 300 feet.

Estimations for surface disturbance:

- Access Roads: = 0.2 acres disturbance per access road (14 foot-wide x 570 feet travel way)
- Drill Pads: = 2.0 acres disturbance per well pad (300 feet x 300 feet)

Proposed Action

Under the proposed action, if all 36 parcels are leased and subsequently fully developed, up to 401 wells could be drilled resulting in up to approximately 917 acres of surface disturbance. Table 2 below lists the potential acres of development within each proposed lease parcel.

Table 2. Potential development within each proposed lease parcel (Proposed Action)

Parcel	Acres	Potential # of Wells	Potential acres disturbed
NM-201607-001 T.0160S, R.0270E, 23 PM, NM Sec. 003 LOTS 1-16; 003 S2	871.840	25	55
NM-201607-002 T.0240S, R.0280E, 23 PM, NM Sec. 006 LOTS 2,3	79.920	3	7

Parcel	Acres	Potential # of Wells	Potential acres disturbed
NM-201607-003 T.0230S, R.0290E, 23 PM, NM Sec. 028 E2E2	160.000	5	11
NM-201607-004 T.0240S, R.0290E, 23 PM, NM Sec. 018 NENW	40.000	2	4
NM-201607-005 T.0240S, R.0290E, 23 PM, NM Sec. 018 LOTS 4	39.840	2	4
NM-201607-006 T.0240S, R.0300E, 23 PM, NM Sec. 013 SESE	40.000	2	39
NM-201607-007 T.0200S, R.0320E, 23 PM, NM Sec. 008 SESE	40.000	2	4
NM-201607-008 T.0230S, R.0320E, 23 PM, NM Sec. 024 NW	160.000	5	11
NM-201607-009 T.0230S, R.0320E, 23 PM, NM Sec. 035 W2	320.000	9	20
NM-201607-010 T.0200S, R.0330E, 23 PM, NM Sec. 028 S2SW,SWSE	120.000	4	9
NM-201607-011 T.0260S, R.0330E, 23 PM, NM Sec. 030 N2NE,NENW	120.000	4	9
NM-201607-012 T.0220S, R.0340E, 23 PM, NM Sec. 035 N2SW,NWSE	120.000	4	9
NM-201607-013 T.0250S, R.0340E, 23 PM, NM Sec. 014 SW	160.000	5	11
NM-201607-014 T.0250S, R.0340E, 23 PM, NM Sec. 021 NENE	40.000	2	4

Parcel	Acres	Potential # of Wells	Potential acres disturbed
NM-201607-015 T.0250S, R.0340E, 23 PM, NM Sec. 024 NENE,S2NE,S2; 025 ALL T.0250S, R.0350E, 23 PM, NM Sec. 030 NE,E2NW,NESW; 019 LOTS 1-4; 019 E2,E2W2; 030 LOTS 1-4	2,160.080	61	134
NM-201607-016 T.0250S, R.0340E, 23 PM, NM Sec. 035 S2N2	160.000	5	11
NM-201607-017 T.0200S, R.0350E, 23 PM, NM Sec. 014 N2NW,SWNW,SW	280.000	8	18
NM-201607-018 T.0250S, R.0350E, 23 PM, NM Sec. 017 S2; 018 LOTS 1-4; 018 E2W2,SE	799.200	22	48
NM-201607-019 T.0260S, R.0350E, 23 PM, NM Sec. 009 NENE	40.000	2	4
NM-201607-020 T.0260S, R.0350E, 23 PM, NM Sec. 009 NW	160.000	5	11
NM-201607-021 T.0260S, R.0350E, 23 PM, NM Sec. 021 SENE,E2SE	120.000	4	9
NM-201607-022 T.0250S, R.0360E, 23 PM, NM Sec. 003 LOTS 3,4; 003 S2NW,SW; 004 LOTS 1,2; 004 S2NE	481.240	13	29
NM-201607-023 T.0250S, R.0360E, 23 PM, NM Sec. 015 ALL; 022 E2	960.000	27	59
NM-201607-024 T.0250S, R.0360E, 23 PM, NM Sec. 027 ALL	640.000	18	40
NM-201607-025 T.0250S, R.0360E, 23 PM, NM Sec. 033 ALL; 034 ALL	1,280.000	36	79

Parcel	Acres	Potential # of Wells	Potential acres disturbed
NM-201607-026 T.0260S, R.0360E, 23 PM, NM Sec. 003 NE,S2; 010 N2,NESE	840.000	23	51
NM-201607-027 T.0260S, R.0360E, 23 PM, NM Sec. 004 E2,E2W2,NWSW; 009 N2	840.000	23	51
NM-201607-028 T.0220S, R.0380E, 23 PM, NM Sec. 005 LOTS 1-4; 005 S2N2,SE	480.840	13	29
NM-201607-029 T.0220S, R.0380E, 23 PM, NM Sec. 007 NENE	40.000	2	4
NM-201607-030 T.0220S, R.0380E, 23 PM, NM Sec. 033 LOTS 4; T.0230S, R.0380E, 23 PM, NM Sec. 004 LOTS 2; 004 SENW,SW; 009 N2NW	371.200	10	22
NM-201607-031 T.0230S, R.0380E, 23 PM, NM Sec. 005 SESW; 007 S2SE; 008 NWNE,W2,SE; 009 SW; 017 E2NE	880.000	24	53
NM-201607-032 T.0230S, R.0380E, 23 PM, NM Sec. 006 NWSE	40.000	2	4
NM-201607-033 T.0230S, R.0380E, 23 PM, NM Sec. 006 SWSW; 007 N2NW	120.000	4	9
NM-201607-034 T.0230S, R.0380E, 23 PM, NM Sec. 007 W2SW	80.000	3	7
NM-201607-035 T.0260S, R.0380E, 23 PM, NM Sec. 021 LOTS 1-4; 021 NW,S2SW	275.800	8	18

Parcel	Acres	Potential # of Wells	Potential acres disturbed
NM-201607-036 T.0260S, R.0380E, 23 PM, NM Sec. 028 LOTS 1-4; 028 W2 Sec. 033 LOTS 1-4 033 N2NW	516.120	14	31
Total	13,876.080	401	917

AFFECTED ENVIRONMENT

3.0 Introduction

This section describes the environment that would be affected by implementation of the Proposed Action Alternative described in Section 2. Elements of the affected environment described in this section focus on the relevant resources and issues. Only those elements of the affected environment that have the potential to be impacted are described in detail.

Air Resources

Air quality and climate are components of air resources which may be affected by BLM applications, activities, and resource management. Therefore, the BLM must consider and analyze the potential effects of BLM and BLM-authorized activities on air resources as part of the planning and decision making process. Much of the information referenced in this section is incorporated from the Air Resources Technical Report for BLM Oil and Gas Development in New Mexico, Kansas, Oklahoma, and Texas (herein referred to as Air Resources Technical Report, USDI BLM 2014). This document summarizes the technical information related to air resources and climate change associated with oil and gas development and the methodology and assumptions used for analysis.

3.1. Air Quality

The state of New Mexico has divided the state into 12 air quality regions. The BLM Pecos District Office (PDO) lies in region 155 (New Mexico Environment Department--Air Quality Bureau, 2010). The Pecos-Permian Basin Intrastate Air Quality Control Region 155 (AQCR 155) is composed of Quay, Curry, De Baca, Roosevelt, Chaves, Lea, and Eddy Counties. Generally, it includes the areas known as the Southern High Plains and the Middle Pecos River drainage basin (New Mexico Environment Department--Air Quality Bureau, 2010).

The Environmental Protection Agency (EPA) has the primary responsibility for regulating air quality, including six nationally regulated ambient air pollutants. These criteria pollutants include carbon monoxide (CO), nitrogen dioxide (NO₂), ozone (O₃), particulate matter (PM₁₀ and PM_{2.5}), sulfur dioxide (SO₂) and lead (Pb). EPA has established National Ambient Air Quality Standards (NAAQS) for criteria pollutants. The NAAQS are protective of human health and the

environment. The EPA has approved New Mexico's State Implementation Plan and the state enforces state and federal air quality regulations on all public and private lands within the state except for tribal lands and within Bernalillo County. The PDO area attains all national ambient air quality standards.

The area of the analysis is considered a Class II air quality area by the EPA. There are three classifications of areas that attain national ambient air quality standards: Class I, Class II, and Class III. Congress established certain national parks and wilderness areas as mandatory Class I areas where only a small amount of air quality degradation is allowed. All other areas of the United States (US) are designated as Class II, which allow a moderate amount of air quality degradation. No areas of the US have been designated Class III, which would allow more air quality degradation. This class is assigned to attainment areas to allow maximum industrial growth while maintaining compliance with NAAQS. The primary sources of air pollution in the Pecos District area are dust from blowing wind on disturbed or exposed soil, exhaust emissions from motorized equipment, oil and gas development, agriculture, and industrial sources.

Air quality in a given region can be measured by its Air Quality Index value. The Air Quality Index (AQI) is reported according to a 500-point scale for each of the major criteria air pollutants, with the worst denominator determining the ranking. For example, if an area has a CO value of 132 on a given day and all other pollutants are below 50, the AQI for that day would be 132. The AQI scale breaks down into six categories: good (AQI <50), moderate (50-100), unhealthy for sensitive groups (100-150), unhealthy (151-200), very unhealthy (201-300), and hazardous (301-500). The AQI is a national index, the air quality rating and the associated level of health concern is the same everywhere in the country. The AQI is an important indicator for populations sensitive to air quality changes.

Current Pollution Concentrations

AQCR 155 is classified as an attainment area for all criteria pollutants, indicating that the area satisfies all NAAQS. There is no monitoring conducted for lead and carbon monoxide in southeastern New Mexico; however concentrations of these pollutants are expected to be low in rural areas and are therefore not monitored. The New Mexico Environment Department discontinued monitoring for SO₂ in Eddy County due to very low monitored concentrations. Monitoring data for PM₁₀ in southeastern New Mexico is not available due to incomplete data collection.

"Design Values" are the concentrations of air pollution at a specific monitoring site that can be compared to the NAAQS. The 2011 design concentrations of criteria pollutants are listed below in Table 3.

Table 3. 2013 Design Values of Criteria Pollutants in Southeastern NM (U.S. Environmental Protection Agency, 2014)

Pollutant	Design Value	Averaging period	NAAQS	NMAAQs
O ₃	0.066 ppm (Lea County)	8-hour	0.075 ppm ¹	
	0.071 ppm (Eddy County)			
NO ₂	4 ppb (Lea County)	Annual	53 ppb	50 ppb
	2 ppb (Eddy County)			
NO ₂	36 ppb (Lea County)	1-hour	100 ppb ²	
PM _{2.5}	8.4 µg/m ³ (Lea County)	Annual	12.0 µg/m ^{3,3}	
PM _{2.5}	22 µg/m ³ (Lea County)	24-hour	35 µg/m ^{3,4}	

¹Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years

²98th percentile, averaged over 3 years

³3-year average annual mean concentration

⁴3-year average 98th percentile concentration

Mean AQI values for Eddy County were generally in the good range (AQI <50) in 2015. In Eddy County, 89 percent of the days in 2015 were classified as “good”. The median AQI in 2015 in Eddy County was 42 or “good” and the maximum AQI was 80, which is moderate. In the past decade, there was one year (2005) with six days rated as unhealthy for sensitive groups or unhealthy, but there have also been five years with no days that reached the level of “unhealthy for sensitive groups” (U.S. Environmental Protection Agency, 2014a).

Mean AQI values for Lea County were generally in the good range (AQI <50) in 2015. In Lea County, 87 percent of the days in 2015 were classified as “good”. The median AQI in 2015 in Lea County was 39 or “good” and the maximum AQI was 157 on one day, which is unhealthy for sensitive groups. In the past decade there have been four years with three days rated as unhealthy for sensitive groups or unhealthy (2011, 2009, 2006 and 2005); three years with only one day rated as unhealthy for sensitive groups, and three years with no days that reached the level of “unhealthy for sensitive groups” (U.S. Environmental Protection Agency, 2014a).

Hazardous Air Pollutants

The Air Resources Technical Report discusses the relevance of hazardous air pollutants (HAPs) to oil and gas development and the particular HAPs that are regulated in relation to these activities (USDI/BLM, 2014). The EPA conducts a periodic National Air Toxics Assessment (NATA) that quantifies HAP emissions by county in the U.S. The purpose of the NATA is to identify areas where HAP emissions result in high health risks and further emissions reduction strategies are necessary. 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. US EPA has identified 187 toxic air pollutants as HAPs. The 2005 NATA identifies census tracts with estimated total cancer risk greater than 100 in a million. There are no census tracts in New Mexico with estimated total cancer risk greater than 100 in a million. Southeastern New Mexico has a total respiratory hazard index that is among the lowest in the US (U.S. Environmental Protection Agency, 2012).

3.2 Climate

The planning area is located in a semiarid portion of the Chihuahuan Desert, typified by dry windy conditions and limited rainfall (Trewartha and Horn 1980). Components of climate that

could affect air quality in the region are summarized in Table 4 below.

Table 4. Climate Components

Climate Component	Carlsbad	Roswell
Mean maximum summer temperatures	95°F	92°F
Mean minimum winter temperatures	30.9°F	28°F
Mean annual temperature	63.2°F	62°F
Mean annual precipitation	12.2 inches	12.5 inches
Mean annual snowfall	6.4 inches	8.6 inches
Mean annual wind speed	9.3 mph	12 mph
Prevailing wind direction	South	West

The Air Resources Technical Report summarizes information about greenhouse gas (GHG) emissions from oil and gas development and their effects on national and global climate conditions. While it is difficult to determine the spatial and temporal variability and change of climatic conditions, what is known is that increasing concentrations of GHGs are likely to accelerate the rate of climate change.

3.3 Cultural Resources

The project area identified in this EA is located in southeastern New Mexico. Geographically, the area is bounded on the west by the eastern flanks of the Guadalupe Mountains, on the east by the Llano Estacado or ‘Staked Plain’, and is bisected by the Southern Pecos River Valley and Mescalero Plains. Five archaeological regions (the Sacramento Section, Pecos Valley, Southwest Pecos Valley, Mescalero Plains, and Llano Estacado archaeological regions) characterize the cultural resources located within the project area.

Twenty-nine parcels are located in the Mescalero Plain archaeological region, four parcels are located in the Llano-Estacado region, two parcels are located in the Pecos Valley region, and one is located in the Southwest Pecos Valley region.

Archaeological sites in southeastern New Mexico are the reflection of human adaptations to changing environmental conditions. As the environmental conditions changed, the distribution and availability of food (plant and animal) also changed. Archaeological sites often reflect these adaptations in their technology (artifact assemblages), geographical location, and the duration of occupation. Rough chronological sequences have been created that reflect these cultural adaptations, allowing archaeologists to place a site into a cultural tradition or period. These are the Paleoindian (ca. 12,000 - 8,000 B.C.), Archaic (ca. 8000 B.C. - A.D. 950), Formative (ca. A.D. 600 - 1540), Protohistoric (ca. A.D. 1400 - 1821), and Historic (ca. A.D. 1822 to early 20th century) periods. Sites representing any or all of these periods exist within these archaeological regions (Sebastian and Larralde 1989, Hogan 2006, Railey 2013). There are 28 known archaeological sites with a determination of “eligible” or “undetermined” within the proposed lease parcels, all located within the CFO.

3.4 Native American Religious Concerns

TCP is a term that has emerged in historic preservation management and the consideration of Native American religious concerns. TCPs are places that have cultural values that transcend, for instance, the values of scientific importance that are normally ascribed to cultural resources such as archaeological sites.

Native American communities are most likely to identify TCPs, although TCPs are not restricted to those associations. Some TCPs are well known, while others may only be known to a small group of traditional practitioners, or otherwise only vaguely known. A review of existing information indicates the proposed actions are outside any known TCP.

3.5 Paleontological Resources

The primary federal legislation for the protection and conservation of paleontological resources occurring on federally administered lands are the American Antiquities Act of 1906 and the Paleontological Resources Preservation Act of 2009 (PRPA). BLM Manual 8270 and Handbook (H-8270-1) provides guidelines for addressing potential impacts to paleontological resources (BLM 1998). Paleontological resources on state trust lands are protected by state policy from unauthorized appropriation, damage, removal, or use.

Paleontological resources preserved in marine and terrestrial sediments may be found in rocks formed during the late Paleozoic, Mesozoic, and Cenozoic Ages. Detailed data in southeastern New Mexico concerning Pennsylvanian and Permian Age fossils is available because of intense oil and gas exploration where such data is necessary for stratigraphic correlation (age dating) of producing formations. Such information is lacking in nonproducing areas.

Paleontological remains found in isolated Cenozoic terrestrial sediments are perhaps the best known vertebrate fossils found in the Pecos District. These Pleistocene-Holocene fossils are usually associated with lake deposits, caves, or early man's hunting sites. The extent of known paleontological resources in the area is minimal when compared to the amount of sedimentary rocks which may contain fossil remains.

The Potential Fossil Yield Classification (PFYC) is a Geographic Information System (GIS) desktop tool that predicts the likelihood of paleontological resources with a numeric system of 1-5, with 1 having little to no likelihood and 5 having the highest likelihood of vertebrate fossil deposits.

While there are no parcels located in the vicinity of known paleontological resources, this classification is typically found in the Ogallala Formation with alluvial and eolian deposits, and petrocalcic soils of the southern High Plains.

Parcel -022 is located within PFYC 4.

Parcels -30, -031, -032, -033, and -034 are located within PFYC 3.

All other parcels are located within PFYC 2.

3.6 Water Resources

Surface water within the proposed lease sale area is affected by geology, precipitation, and water erosion. Activities that currently affect surface water resources include livestock grazing management, oil and gas development, recreation, and brush control treatments. Surface water is located in perennial and ephemeral springs, ephemeral playas, and stock tanks. The Pecos River is the only water quality impaired stream presently found within the PDO as per the 2008-2010 State of New Mexico Integrated Clean Water Act 303(d) and 305(b) Report. The designated use listed is warm water fishery. Listed probable sources of impairment include natural sources (the Malaga salt dome), irrigation, loss of riparian habitat, flow alterations from water diversions, rangeland grazing, and stream bank modifications and destabilization.

Groundwater within the PDO is affected by geology and precipitation. Activities that currently affect groundwater resources include livestock grazing management, oil and gas development, and groundwater pumping. Groundwater within the PDO can be obtained from groundwater aquifers located within the Rustler, Castile, Tansill, Yates, Seven Rivers, Queen, Grayburg, Artesia, Ogallala, and Chinle Formations, the Capitan and San Andres Limestones, the Glorieta and Santa Rosa Sandstones, and the Dockum Group. Most of the groundwater exists in unconfined aquifers, although confined groundwater aquifers exists under artesian conditions in the San Andres Formation. The depth to shallow unconfined groundwater varies from one foot to 400 feet throughout the CFO (New Mexico Office of the State Engineer data). The depth to confined groundwater can be greater than 400 feet. Most of the groundwater is used for agricultural, industrial, rural, domestic, and livestock purposes.

Sinks and playas could be located within a proposed lease boundary that may hold water after frequent heavy rains. Intermittent drainages may also cut across one or more of the proposed lease boundaries.

Known playas are located within a portion or within 200 meters of the boundary of parcels -003, -031.

Known Streams, Rivers, or Floodplains are located within a portion or within 200 meters of the boundary of parcels -003, -004, -005, -022, -023, -025, -027, -028, -030, -031, -033, -034, -035, and -036.

There are no known springs, seeps or dirt tanks located within a portion of, or within 200 meters of the proposed parcels.

3.7 Wetlands, Riparian and Floodplains

Most often ephemeral in desert watersheds, floodplains range in width from under one-half mile to over one mile. In desert watersheds, including the PDO, floodplains may appear to be little more than gentle draws. However, they can quickly become dangerous torrents in periods of monsoonal rainstorms. Regardless, they are important water sources for animals and plants in the Chihuahuan Desert. For administrative purposes, the 100-year floodplain serves as the basis for floodplain management on public lands. The Federal Emergency Management Agency (FEMA)

defines the 100-year floodplain. These are in general relatively narrow areas along natural drainage ways that carry large quantities of runoff following periods of high precipitation.

Playas are ephemeral, round hollows in the ground located mainly on the Southern High Plains of the US. They are important water sources for animals and plants in the Chihuahuan Desert. After rainstorms, freshwater collects in the round depressions of the otherwise flat landscape of west Texas and eastern New Mexico. There are also many saltwater-filled playas in the PDO, known as alkali lakes. These are fed by water from underlying aquifers, which brings salt with it as it percolates up through the soil. As the water evaporates, the salt is left behind in the increasingly salty playas.

Springs and seeps are fed by groundwater from shallow aquifers. Their emergence is a function of hydro-geological, geological, and topographical conditions and interrelation among them. Earthen tanks are drainage catchments normally used for livestock watering; however, in the Chihuahuan Desert, they also offer isolated and limited water for plants, wildlife, and domestic and commercial purposes.

Known playas are located within a portion or within 200 meters of the boundary of parcels -003 and -031.

Known Streams, Rivers, or Floodplains are located within a portion or within 200 meters of the boundary of parcels -003, -004, -005, -022, -023, -025, -027, -028, -030, -031, -033, -034, -035, and -036.

There are no known springs, seeps or dirt tanks located within a portion of, or within 200 meters of the proposed parcels.

3.8 Soils

The Carlsbad Resource Management Area can be divided into four general soil types as referenced in the following Soil Surveys: Eddy Area and Lea County, New Mexico. These are shallow, loamy, sandy, and gypsum.

The shallow type is primarily soils of the Ector and Upton series. Several other minor soil mapping units are found in this type. These soils are shallow to very shallow, well-drained, calcareous, stony and rocky loams over limestone and caliche. Topography ranges from nearly level ridgetops to steep side slopes to cliffs and escarpments. Permeability is moderate, water-holding capacity is very low to low, and runoff is rapid after the soils become saturated. They are subject to water erosion, but the stones and rock outcrops help to stabilize the soils on nearly level to gently sloping areas.

Loamy soils are primarily in the Reagan, Reeves, and Anthony series, while other minor soil mapping units also exist within this type. Generally these soils are deep, well-drained, moderately dark colored, calcareous, and loamy, located on gently undulating plains and in the broader valleys of the hills and mountains. Permeability is moderate, water-holding capacity is moderate to high, and runoff is likely after prolonged or heavy rains.

The sandy type has predominately soils from the Pyote, Kermit, Berino, Pajarito, and Wink series. Other soil mapping units make up a minor part of this type. Typically, these soils are deep, well-drained to excessively drained, non-calcareous to weakly calcareous sands. They are found on undulating plains and low hills in the “sand country” east of the Pecos River. Permeability is moderate to very rapid, water-holding capacity is low to moderate, with little runoff.

Gypsum soils are primarily in the Cottonwood and Gypsum land series. These soils have a loamy surface layer, with gypsiferous materials starting at a depth of one to 10 inches. They are found on gently undulating uplands, with steep, broken gypsum outcrops. Permeability varies from very low to moderate, water-holding capacity is very low to low, and runoff rapid to very rapid. Soil fertility and the rooting zone are limited by the underlying gypsiferous material.

All of the aforementioned soil types are susceptible to wind erosion and careful management is needed to maintain a cover of desirable forage plants and to control erosion. Revegetation is difficult once the native plant cover is lost due to high temperatures and unpredictable rainfall.

Biological soil crusts are scattered throughout the proposed lease sale area in nutrient-poor areas between plant clumps. These include cyanobacteria, squamulose lichens, and gelatinous lichens. Because they lack a waxy epidermis, they tend to leak nutrients into the surrounding soil. Vascular plants such as grasses and forbs can then utilize these nutrients. They also function in the nutrient cycle by fixing atmospheric nitrogen, contributing to soil organic matter, and maintaining soil moisture. In addition, they can act as living mulch that discourages the establishment of annual or invasive weeds.

Cyanobacteria are the most common in the proposed lease sale area. These soil crusts are important in binding loose soil particles together to stabilize the soil surface and reduce erosion. Cyanobacteria are mobile, and can often move up through disturbed sediments to reach light levels necessary for photosynthesis. Structurally, cyanobacteria form an uneven, rough carpet that reduces raindrop impact and slows surface runoff. Lichens, rhizines, and cyanobacterial filaments act to bind the soil surface particles just below and at the surface. Disturbed crusts, particularly lichens, can take from 10 to as many as 100 years to recover.

Parcels -001, -004, -005, -010, -012, -015, -017, -026, -027, -028, -029, -030, -035, and -036 contain fragile soils or steep slopes.

3.9 Vegetation

In general, the lease parcels are grassland sites with warm season mid and short grasses. There is a fair scattering of shrubs and half-shrubs throughout the landscape, although in some places shrubs have invaded to the point of dominating the vegetative component. Forb production fluctuates from season to season and year to year.

The majority of shallow soil types are made up of the gravelly, shallow, very shallow, and limestone hills range sites. The potential plant community consists primarily of grasses such as black grama, sideoats grama, hairy grama, muhlys, dropseeds, and tridens, with shrubs such as cresote bush, mesquite, mariola, and catclaw mimosa as well. Yucca, sacahuista, mariola, and

catclaw mimosa become more prevalent on north and east slopes. In deteriorated condition, this type of site would show an increase in woody plants and grasses such as three-awns, fluffgrass, and hairy tridens.

Range sites such as loamy, swale, bottomland, and draws make up most of the loamy type. The potential plant community consists of blue grama, black grama, sideoats grama, and tobosa. Fourwing saltbush, tarbush, and yucca are the principal shrubs. Forbs include croton, filaree, globemallow, and desert holly. Invasive species such as three-awns, burrograss, snakeweed, mesquite, creosote, and cholla cactus spread as ecological conditions decrease.

Sandy soil types are dominated by deep sand, sand hills, and sandy range sites. The potential plant community consists of dropseeds (sand, spike, and mesa), bluestems, and black grama. Yucca, fourwing saltbush, and shinnery oak are the principle shrub species. If environmental conditions deteriorate, plants such as three-awns and mesquite would increase and soil hummocking would occur.

Gypsum soil types are dominated by gypsum hills and gypsum flats range sites. The potential plant community located in gypsum consists of gyp grama, gyp dropseed, coldenia, yucca, and ephedra. Black grama, blue grama, alkali sacaton, tobosa, and fourwing saltbush can be found in the loamy pockets included in the gypsum areas. Tarbush, broom snakeweed, and mesquite invade in disturbed areas.

3.10 Noxious Weeds

All field-going PDO personnel continually inventory the presence of species described in the Noxious Weed List for the State of New Mexico (NMDA, 2009). The inventory process is ongoing in order to detect invasive populations when they are small. Once a population is found, the CFO coordinates with various agencies, lease operators, and the land user to remove or control the population.

Populations of noxious weeds, primarily African rue and Malta star thistle, are scattered throughout the proposed lease sale area. Project activities, even with preventative management actions, could result in the establishment and spread of noxious weeds on disturbed sites throughout portions of the area. Most of the noxious weeds exist mainly along the shoulders of county roads, lease and private roads, and on production pads within the area.

3.11 Special Status Species

Special status species of concern in this area include the dunes sagebrush lizard (DSL).

Dune Sagebrush Lizard

The dune sagebrush lizard (*Sceloporus arenicolus*) is a species with a limited geographic range including parts of Chaves, Eddy, Lea, and Roosevelt Counties of southeastern New Mexico and four counties in Texas. The DSL is a habitat specialist, found exclusively in association with shinnery oak dune complexes. These complexes are patchworks of shinnery oak and scattered sand sagebrush interspersed with areas of open sand and wind-created sandy blowouts. These complexes create ideal habitat for the DSL.

The DSL may also require specific sand particle size. Research has shown that there are significant differences in the composition of sand between sites that are occupied and unoccupied by DSLs. Occupied sites have slightly coarser sand than unoccupied sites. This suggests that the DSL may not inhabit areas with high percentages of sand particles smaller than 250 micrometers (Fitzgerald et al, 1997).

The USFWS were petitioned on May 28, 2002 by The Center for Biological Diversity and Chihuahuan Desert Conservation Alliance to list the DSL as an endangered species under the ESA. In May 2005 the USFWS issued a statement regarding their status review of the DSL. It stated, "Protection of the sand dune lizard under the Federal Endangered Species Act (ESA) is warranted but precluded, which means that other species in greater need of protection must take priority in the listing process." Given the current Federal Candidate status of this species, the BLM is mandated to carry out management, consistent with the principles of multiple use, for the conservation of candidate species and their habitats and shall ensure that actions authorized, funded, or carried out do not contribute to the need to list any of these species as Threatened or Endangered (BLM Manual 6840). On December 13, 2010, the USFWS published in the Federal Register a proposal to list the sand dune lizard (Dune Sagebrush Lizard) as federally endangered under the Endangered Species Act of 1973. On June 13, 2012, the USFWS published in the Federal Register notice that the proposed rule to list the DSL as endangered was withdrawn based on their conclusion that the threats to the species as identified in the proposed rule no longer are as significant as believed at the time of the proposed rule. The conclusion was based on their analysis of current and future threats and conservation efforts. They found the best scientific and commercial data available indicate that the threats to the species and its habitat have been reduced to the point that the species does not meet the statutory definition of an endangered or threatened species.

Parcels -007 and -017 are located within potentially suitable habitat for the DSL.

3.12 Threatened and Endangered Species

Under Section 7 of the ESA of 1973 (as amended), the BLM is required to consult with the USFWS on any proposed action which may affect Federal listed threatened or endangered species or species proposed for listing.

Effects of oil and gas leasing and development on threatened or endangered species were first analyzed in Section 7 consultation for the 1997 RFO RMP and 1997 CFO RMPA (Cons. # 2-22-96-F-128). The USFWS response can be found in Appendix 11 of the 1997 Approved Roswell RMP and Appendix 4 of the 1997 Carlsbad RMPA.

In April 2008, the BLM Pecos District Special Status Species RMPA amended both these land use plans in portions of Chaves, Eddy, Lea, and Roosevelt Counties, as described in that document, to ensure continued habitat protection of two special status species, the LPC and the DSL. This action is in compliance with threatened and endangered species management outlined in the September 2006 US Fish and Wildlife Consultation (Cons. # 22420-2007-TA-0033) and in accordance with the requirements of FLMPA of 1976 and NEPA of 1969.

On March 27, 2014, the USFWS published in the Federal Register the final rule to list the LPC as threatened under ESA. The BLM entered into Section 7 consultation regarding its leasing program and subsequent development. Any lease parcel that may be affected by the Section 7 consultation would not be leased until the consultation with the USFWS has been completed.

Lesser Prairie-Chicken

Sand shinnery communities extend across the Southern Great Plains, occupying sandy soils in portions of north and west Texas, west Oklahoma, and southeast New Mexico. Portions of Eddy, Lea, and Chaves Counties consist largely of sand shinnery habitat and are intermixed with areas of mesquite to a lesser degree. The characteristic feature of these communities is co-dominance by shinnery oak and various species of grasses. In New Mexico, shinnery oak inhabits sandy soil areas, often including sand dunes.

In New Mexico, the lesser prairie-chicken formerly occupied a range that encompassed the easternmost one-third of the state, extending to the Pecos River, and 30 miles west of the Pecos near Fort Sumner. This covered approximately 14,672 square miles. By the beginning of the 20th century, populations still existed in nine eastern counties of New Mexico (Union, Harding, Chaves, De Baca, Quay, Curry, Roosevelt, Lea, and Eddy). The last reliable records from Union County are from 1993. Currently, populations exist only in parts of Lea, Eddy, Curry, Chaves, and Roosevelt Counties, comprising about 23 percent of the historical range.

LPCs are found throughout dry grasslands that contain shinnery oak or sand sagebrush. Currently, they most commonly are found in sandy-soiled, mixed-grass vegetation, sometimes with shortgrass habitats with clayey or loamy soils interspersed. They occasionally are found in farmland and smaller fields, especially in winter. Shinnery oak shoots are used as cover and produce acorns, which are an important food for LPCs and many other species of birds, such as the scaled quail, northern bobwhite, and mourning dove. 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.

LPCs use a breeding system in which males form display groups. These groups perform mating displays 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, but in New Mexico, leks are just as likely to be on flat areas such as roads, abandoned oil well pads, dry playa lakes, or at the center of wide, shallow depressions. Leks may be completely bare, covered with short grass, or have scattered clumps of grass or short tufts of plants. An important physical requirement for the location of leks is the visibility of surroundings, but the most important consideration is proximity of suitable nesting habitat, breeding females and the ability to hear male vocalizations.

In the late 1980s, there were 35 documented active booming grounds known to exist within the CFO. Due to population decreases and unpredictable weather cycles the LPC is currently listed as a federally threatened species, and is defined as a species having the potential to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Parcels -006, -007, -008, -009, -010, -012, -013, -014, -015, -016, -017, -018, -019, -020, -021, -028, and -030 include suitable habitat for lesser prairie-chicken. The 2008 Special Status Species RMPA defines occupied habitat as “all areas within 1.5 miles of an active lesser prairie chicken site, regardless of vegetation that has been active for one out of the last 5 years.” The boundaries of the lease parcels discussed are greater than 1.5 miles from an LPC siting or an LPC lek. Therefore leasing of these parcels is in conformance with the management decisions, criterion, and appropriate lease stipulations (see Table 1 and Appendix 1) for leasing within the isolated population area as set forth in the 2008 RMPA.

3.13 Wildlife

Mammals known to live throughout the CFO include various species of bats, desert cottontail, black-tailed jackrabbit, spotted ground squirrel, rock squirrel, pocket gopher, porcupine, coyote, gray fox, bobcat, raccoon, striped skunk, spotted skunk, mule deer, pronghorn, wood rat, and various other small rodents. Upland game bird species may include scaled quail, bobwhite quail, mourning dove, and lesser prairie-chicken. Several raptors inhabit the area, including Harris hawks, Swainson’s hawks, and western burrowing owls.

Several raptor species use the southeastern New Mexico region as either migratory or permanent residence. Potential nesting habitat includes, but is not limited to, escarpments, cliff faces, and any tree large enough to support a nest. Nesting territories of some raptors remain remarkably stable from year to year. Furthermore, several species seldom build new nests, but repeatedly repair and reuse old ones. Alternate nest sites are contained within territories; therefore a specific nest site may change annually. Limits of territories remain essentially constant (Newton 1979). The grasslands, riparian, and xeric-riparian areas provide hunting grounds. The area has an abundant food base to support a substantial population of raptors year round in most years.

Migratory Birds

Executive Order #13186 titled “Responsibilities of Federal Agencies to Protect Migratory Birds” signed January 10, 2001 requires that the BLM evaluate the effects of federal actions on migratory birds. A migratory bird inventory has not been completed for this area but would be conducted upon receiving an APD for a select parcel. Common migratory birds which may use the area as habitat include various species of song birds, owls, ravens, hawks, finches, doves, thrashers, and meadowlarks.

3.14 Range

The proposed action covers all or parts of fourteen grazing allotments; Pierce Canyon, Twin Wells, Swag, Halfway, Goedeke Grazing Cell, Sam Simon Swale, Red Tank, Medlin Wells, Monument Draw, Javelina Basin, Clayton Basin, Andrews Flat, Pecos River, and Harroun Lake.

The allotments are run as a year-long cow-calf operation. Most of the grazing permittees follow some type of deferred-use rotation system, in which one or more pastures within the allotment receive some growing rest. Range improvement projects such as windmills, water delivery systems (pipelines, storage tanks, and water troughs), earthen reservoirs, fences, and brush control projects are located within the proposed lease sale area. In general, an average rating of the rangeland within this area is six acres per animal unit month (AUM). One cow requires

approximately 72 acres per year, allowing about nine cows per section.

3.15 Visual Resources

There are four categories of Visual Resource Management Objectives. Each of the different class objectives are described below with the appropriate lease parcels noted.

Class I Objective

The objective of this class is to preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.

No lease parcels are within Class I Objectives.

Class II Objective

The objective to this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.

No lease parcels are within Class II Objectives.

Class III Objective

The objective of this class is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.

The following lease parcels are within Class III Objectives: -004 and -005.

Class IV Objective

The objective of this class is to provide for management activities which require major modification 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.

All other lease parcels are located in areas managed under Class IV Objectives.

3.16 Recreation

The proposed lease parcels, except for parcels -002, -005, -012, -013, -022, -023, -024, -025, -026, -027 -028, -029, -030, -031, -032, -033, -034, -035, and -036, are all within dispersed recreation areas subject to public use. Dispersed recreation areas are areas that are used by recreationists as they desire. The CFO is flanked on the west by the Guadalupe Mountains, the Pecos River Valley which cuts the resource area roughly in half, and the sand dunes which

dominate the eastern half of the CFO. The river is favored by the public for fishing, camping, hunting, and other outdoor recreation activities. The sand dunes east of Carlsbad, New Mexico include two Off-Highway Vehicle (OHV) sites used mainly for four-wheeling. The Guadalupe Mountains provide various hiking and hunting opportunities. Activities from hunting and four-wheeling to hiking, horseback riding and bird watching are popular in dispersed recreation areas.

3.17 Cave/Karst

Portions of the project area are located in gypsum karst terrain- a landform that is characterized by underground drainage through solutionally enlarged conduits. Gypsum karst terrain may contain sinkholes, sinking streams, caves, and springs. Sinkholes leading to underground drainages and voids are common. These karst features, as well as occasional fissures and discontinuities in the bedrock, provide the primary sources for rapid recharge of the groundwater aquifers of the region.

The BLM categorizes all areas within the PDO as having either low, medium, high, or critical cave potential based on geology, occurrence of known caves, density of karst features, and potential impacts to fresh water aquifers. A high karst zone is defined as an area occurring in known soluble rock types and containing a high frequency of significant caves and karst features such as sinkholes, bedrock fractures that provide rapid recharge of karst aquifers, and springs that provide riparian habitat. A medium karst zone is defined as an area occurring in known soluble rock types but may have a shallow insoluble overburden. These areas may contain isolated karst features such as caves and sinkholes. Groundwater recharge may not be wholly dependent on karst features but the karst features still provide the most rapid aquifer recharge in response to surface runoff.

Sinkholes and cave entrances collect water and can accumulate rich organic materials and soils. This, in conjunction with the stable microclimate near cave entrances, support a greater diversity and density of plant life which provides habitat for a greater diversity and density of wildlife such as raptors, rodents, mammals, and reptiles.

The interior of the caves support a large variety of troglobitic, or cave environment-dependent species. The troglobitic species have adapted specifically to the cave environment due to constant temperatures, constant high humidity, and total darkness. Many of the caves in this area contain fragile cave formations known as speleothems.

Parcel -001 is located within a high cave/karst zone.

Parcels -002, -003, -004, -005, and -011 are located within a medium cave/karst zone.

All remaining parcels are located within a low cave/karst zone.

3.18 Socioeconomics and Environmental Justice

Socioeconomics

Southeastern New Mexico is rural in nature with approximately 13 persons per square mile (14,663 square miles). The population of Lea County has grown the fastest in the recent decade

at about 16.6 percent, after a slight decline from 1990 to 2000. Eddy County has been growing steadily over the past two decades, with a slight lag in population growth.

Area	Resident Population				Percent Population Change		
	1990 Census	2000 Census	2010 Census	2020 Projection	1990–2000 (Actual)	2000–2010 (Actual)	2010–2020 (Estimate)
New Mexico	1,515,069	1,819,046	2,059,179	2,540,145	20.1	13.2	19.0
Eddy County	48,605	51,658	53,829	58,284	6.3	4.2	8.2
Lea County	55,765	55,511	64,727	67,479	-0.5	16.6	4.2

Natural resource development and use has shaped the social and economic landscape of Eddy and Lea Counties over the last 100 years. Ranching, oil and gas development, potash mining, and recreation have all been important factors in creating the current socioeconomic conditions in southeastern New Mexico. Potash mining and oil and gas development have been intrinsic to shaping the communities within the area. Residents have experienced the boom and bust cycles of natural resource extraction since the early 1900s. In order to mitigate the risk of boom and bust cycles associated with these industries, the counties and communities continue to highlight economic diversification in their development goals. Both counties are actively pursuing and recruiting new businesses from non-traditional sectors and encouraging growth in existing sectors.

Total job growth in New Mexico from 2001 to 2009 was 11 percent. Growth in Lea County averages 20 percent growth and Eddy County averaged 23 percent growth. In both counties, approximately half of the new jobs added were in the mining and construction sectors. The mining industry supports the most jobs (22 percent in Lea County and 16 percent in Eddy County), followed by government (13 percent and 11 percent, respectively) and retail trade (10 percent). Unemployment in the counties has remained below the national average.

Unemployment in April 2015 was at 4.8 percent in Lea County and 4.3 percent in Eddy County (BLS 2015). The median household income (2009-2013) in Lea County is \$50,694, while it is \$49,165 in Eddy County, which are both higher than the State of New Mexico median income of \$44,927. Approximately 15.0 percent of the population in Lea County and 12.5 percent in Eddy County lives below the poverty level, which are both lower than the statewide 20.4 percent (Census Bureau 2015).

Environmental Justice

Executive Order 12898, issued on February 11, 1994, addresses concerns over disproportionate environmental and human health impacts on minority and low-income populations. The impetus behind environmental justice is to ensure that all communities, including minority, low-income, or federally recognized tribes, live in a safe and healthful environment. The July 2016 Oil and Gas Lease Sale would be in conformance with this executive order.

In 2010, minorities made up 60 percent of the population in the state of New Mexico compared to 36 percent in the United States as a whole. While the population of minorities in Lea and Eddy Counties (57 percent and 48 percent, respectively) substantially exceeded the United States, it was below the state average. Based on the definition of a minority population (minority residents exceed 50 percent of all residents), Artesia (55 percent) and Loving (80 percent) in Eddy County and Hobbs (62 percent), Lovington (68 percent), and Jal (50 percent) in Lea County are all

considered “minority populations” under Environmental Justice (Census Bureau 2010). Hispanics make up 49 percent of the total population and about 91 percent of the minority population.

Artesia and Loving are also considered environmental justice populations as determined by low-income status.

There are no minority or low income populations located within or nearby the parcels described in the proposed action. Artesia is approximately 10 miles southwest of parcel -001. Loving is approximately three miles northeast of parcel -002 and approximately six miles west and northwest of parcels -003, -004 and -005. Jal is approximately five miles east of parcels -022, -023, -024, -025, -026, and -027 and approximately nine miles west of parcels -035 and -036. Eunice is approximately five miles west of parcels -028 and -029 and approximately nine miles north of parcels -030, -031, -032, -033, and -034. Hobbs, Lovington, and Carlsbad are all greater than 20 miles from any parcel. However, there may be minority or low-income individual properties that are outside the city limits near the split-estate parcels.

3.19 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 (SPA). The Secretary’s 2012 Order was written to establish rules for concurrent operations in prospecting for, development and production of oil and gas and potash deposits owned by the United States within the designated SPAs. The SPA completely encompasses the Known Potash Leasing Area which was established for the administration of potassium leasing.

The SPA is comprised of five classifications respective to the density of core holes or geophysical inference. These classifications are: Measured Ore (Potash Enclave), Indicated Ore, Inferred Ore, Barren of Potash Ore, and no core data (not known barren).

Measured Ore are potash resources for which tonnage is computed from dimensions revealed in workings and drill holes. The grade is computed from the results of detailed sampling. Measured ore would be delineated by data points no more than 1.5 miles apart if geologic inference shows these projections to be reasonable. Measured ore would not be delineated by fewer than three data points that meet all other distance, thickness, and grade criteria. Measured ore is not projected further than 1.5 miles from a data point which meets thickness and quality standards where no projection or geologic inference data exists.

Indicated Potash Reserves are identified as potash resources that are computed partly from specific measurements, samples, or production data and partly from projection for a reasonable distance on geologic evidence. The sites available for inspection, measurement, and sampling are too widely or otherwise inappropriately spaced to permit the mineral bodies to be outlined completely or the grade established throughout.

Inferred Potash resources are identified as potash resources which are probable, but tonnage and grade cannot be computed due to the absence of specific data. Lithologic descriptions and Gamma logs indicate probable mineralization, and the data can be reasonably correlated.

Barren and/or minor potash mineralization areas are composed of sub economic resources that would require a substantially higher market value or major cost reducing technology for economical production. Sub economic resources also include other minerals not presently being recovered.

No core hole data are areas where there is no data to suggest that the area is Measured, Indicated, Inferred, and/or Barren of potash mineralization.

Parcels -003, -007, and -010 are located within the R-111-P Boundary, also known as the Known Potash Leasing Area (KPLA). Parcel -006 is located within the 2012 Secretary Potash Area. These parcels would require special casing design to protect the salt from objective oil and gas formations below.

While parcel -008 is not located within the 2012 Secretary Potash Area, it is located over the planned Ochoa Potash Mine.

ENVIRONMENTAL IMPACTS

4.0 Environmental Consequences

4.1 Assumptions for Analysis

The act of leasing parcels would, by itself, have no impact on any resources in the CFO. All impacts would be linked to an undetermined future level of lease development. The anticipated level of full lease development is described in Table 2 in Section 2.3.1. If lease parcels were developed, short-term impacts would be stabilized or mitigated within five years and long-term impacts are those that would substantially remain for more than five years. Potential impacts and mitigation measures are described below.

Assumptions used in the analysis regarding resource impacts are based on past development knowledge and practices and resource concerns specific to each individual parcel. Site-specific impacts would be addressed in a subsequent NEPA document when an APD is received.

Cumulative impacts include the combined effect of past projects, specific planned projects, and other reasonably foreseeable future actions such as other infield wells being located within these leases. Potential cumulative effects may occur should an oil and gas field be discovered, if these parcels are drilled and other infield wells are drilled within these leases, or if these leases become part of a new unit. All actions, not just oil and gas development may occur in the area, including non-federal actions.

4.2 Effects from the No Action Alternative

Under the No Action Alternative, the 36 parcels totaling 13,876.08 acres nominated for sale in the July 2016 Oil and Gas Lease sale would be deferred and not offered for sale. There would be no subsequent impacts from oil and/or gas construction, drilling, and production activities. The No Action Alternative would result in the continuation of the current land and resource uses in the proposed lease areas.

4.2.1 Mineral Resources

There would be no new impacts from oil and gas production on the proposed parcel land. Oil and gas development of federal, state, private, and Indian minerals would continue on the land surrounding the proposed parcels. No additional natural gas or crude oil from the proposed parcels would enter the public markets and no royalties would accrue to the federal and state treasuries. An assumption is that the No Action Alternative (no lease option) would not affect current domestic production of oil and gas. However, this may result in reduced Federal and State royalty income, and the potential for Federal land to be drained by wells on adjacent private or state land. Oil and gas consumption is driven by a variety of complex interacting factors including energy costs, energy efficiency, availability of other energy sources, economics, demography, and weather or climate. If the BLM were to forego leasing and potential development of the proposed parcels, the assumption is that the public's demand for the resource would not be expected to change. Instead, the mineral resource foregone would be replaced in the short- and long-term by other sources that may include a combination of imports, using alternative energy sources (e.g. wind, solar), and other domestic production. This offset in supply would result in a no net gain for oil and gas domestic production.

4.2.2 Environmental Justice

By not leasing the proposed parcels under the No Action Alternative, there may be negative effects on the overall employment opportunities related to the oil and gas and service support industry, as well as a loss of the economic benefits to state and county governments related to royalty payments and severance taxes. However, there would be no increase in activity and noise associated with these proposed leases unless the land is used for other purposes.

4.2.3 All Other Resources

No other resources would be affected under the No Action Alternative, as there would be no surface disturbance that could detrimentally affect these resources. The No Action Alternative would result in the continuation of the current land and resource uses on the parcels. However, the selection of the No Action Alternative would not preclude these parcels from being nominated and considered in a future lease sale, which would result in impacts as described under the Proposed Action.

4.3 Analysis of the Proposed Action

4.3.1 Air Quality

Leasing the subject tracts would have no direct impacts to air quality. Any potential effects to air quality from sale of lease parcels would occur at such time that the leases were developed. Potential impacts of development would include increased air borne soil particles blown from new well pads or roads, exhaust emissions from drilling equipment, compressor engines, vehicles, flares, exhaust and fugitive dust emissions from operation and maintenance, and dehydration and separation facilities, and volatile organic compounds during drilling or production activities.

In order to reasonably quantify emissions associated with well exploration and production activities, certain types of information are needed. Such information includes a combination of activity data such as the types of equipment needed if a well were to be completed successfully (e.g. compressor, separator, dehydrator), the technologies which may be employed by a given company for drilling any new wells, area of disturbance for each type of activity (e.g. roads, pads, electric lines, compressor station), number of days to complete each kind of construction, number of days for each phase of drilling process, type, size, number of heavy equipment used for each type of construction (backhoe, dozer, etc.), number of wells of all types (shallow, deep, exploratory, etc.), compression per well (sales, field booster), or average horsepower for each type of compressor.

The degree of impact would also vary according to the characteristics of the geologic formations from which production occurs. Currently, it is not feasible to directly quantify emissions; however, the potential development scenarios that could result from selection of the proposed action are described in Table 3. What can be said is that exploration and production would contribute to incremental increases in overall air quality emissions associated with oil and gas exploration and production into the atmosphere.

Although the hydraulic fracturing of wells within a lease parcel is hard to predict, it is anticipated that with more wells being drilled, there would be an increase in the amount of wells being hydraulically fractured and completed.

When hydraulic fracturing takes place after a well is drilled, multiple diesel-burning pumps build the high pressures needed to move large quantities of fracturing fluids and to cause fracturing in the target shale formation. After the shale is fractured, an initial mixture of gas, hydrocarbon liquids, water, sand, or other materials returns to the surface as “flowback.” While federal regulations require that hydraulically fractured gas wells employ “Reduced Emission Completion” (REC) techniques to avoid the venting and flaring of gas, oil wells are not required to use REC techniques. Although REC techniques can be applied to oil well completions, natural gas has typically been vented to the atmosphere or flared while fracturing fluids that include sand, water, and other liquids are directed into holding tanks. After the mixture is relatively free of water, sand, and gas, and has achieved the required pipeline quality, the well can be connected to the permanent gas collecting pipes (if existing) at the well site.

During the well completion phase, the most significant emissions of criteria pollutants emitted are volatile organic compounds, (VOCs), particulate matter and NO₂. VOCs and NO_x contribute to the formation of ozone, a pollutant of concern. Data provided to EPA's Natural Gas STAR Program show that some of the largest air emissions in the natural gas industry occur while recently fractured wells are being prepared for production. During completion operations, flowback, fracturing fluids, water and reservoir gas return to the surface at high velocity and volume. This mixture includes a high volume of VOCs and methane, along with potential air toxics such as benzene, ethylbenzene, and n-hexane. These levels are anticipated to be so minor that impacts to human health are not anticipated. The typical flowback process lasts from three to 15 days. Due to differences in the quantities and concentrations of fracturing chemicals used, to the lack of maximum contaminant levels or thresholds for them, and to the possibility of chemical reactions during the mixing of hydraulic fracturing fluids, it is difficult to quantify emissions and resulting public health risks. A 2012 study in Garfield County, Colorado (Lisa M. McKenzie, 2012) calculated health risks based on monitoring data for residents living less than one-half mile and more than one-half mile from hydraulically fractured wells. Cumulative cancer risks were 10 in a million and six in a million for residents living within one-half mile and more than one-half mile from wells, respectively, with benzene as the major contributor to risk. The authors concluded that air emissions from hydraulic fracturing warranted further study. A recent study in the Barnett Shale region (A.G. Bunch, 2014) that examined data from seven air monitors tracking up to 105 specific VOCs found no exceedance of federal and state health-based air comparison values for chemicals associated with shale gas production activities. Required REC techniques are intended to capture all VOCs and methane during the completion process, but REC techniques are not mandatory for oil well completions. Due to safety concerns, hydraulic fracturing oil well completion operations will employ flaring or REC techniques to capture or combust VOCs and methane. Flaring reduces VOC emissions from completion by 95 percent.

If gas venting or flaring was used, CO, CH₄ and VOC/HAPs would be emitted to the atmosphere; if the gas was "sour," sulfur dioxide would be emitted during flaring. Emissions from flaring would be short-term, typically lasting less than 30 days to remove unwanted components of the produced natural gas. After those unwanted components were removed, natural gas would be rerouted to gathering pipelines for transport to market.

Potential Mitigation

The BLM encourages industry to incorporate and implement BMPs, which are designed to reduce impacts to air quality by reducing emissions, surface disturbances, and dust from field production and operations. Typical measures include: adherence to BLM's NTL 4(a) concerning the venting and flaring of gas on Federal leases for natural gas emissions that cannot be economically recovered; flare hydrocarbon gases at high temperatures in order to reduce emissions of incomplete combustion; water dirt roads during periods of high use in order to reduce fugitive dust emissions; co-locate wells and production facilities to reduce new surface disturbance; implementation of directional drilling and horizontal completion technologies whereby one well provides access to petroleum resources that would normally require the drilling of several vertical wellbores; suggest that vapor recovery systems be maintained and functional in areas where petroleum liquids are stored; and perform interim reclamation to revegetate areas of the pad not required for production facilities and to reduce the amount of dust from the pads.

In addition, the BLM encourages industry to participate in the Natural Gas STAR program that is administered by 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.

In October 2012, EPA promulgated air quality regulations for completion of hydraulically fractured gas wells. These rules require air pollution mitigation measures that reduce the emissions of volatile organic compounds during gas well completions.

4.3.2 Climate

The assessment of GHG emissions, their relationship to global climatic patterns, and the resulting impacts is an ongoing scientific process. It is currently not feasible to know with certainty the net impacts from the proposed action 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. The BLM does not have the ability to associate a BLM action and its contribution to climate change with impacts in any particular area. The science to be able to do so is not yet available. The inconsistency in results of scientific models used to predict climate change at the global scale, coupled with the lack 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 determining the significance of any discrete amount of GHG emissions is beyond the limits of existing science. When further information on the impacts to climate change is known, such information would be incorporated into the BLM’s planning and NEPA documents as appropriate. The data found in Tables 5, 6, and 7 is based on the most recently compiled best available information.

Leasing the subject tracts would have no direct impacts on climate as a result of GHG emissions. There is an assumption, however, that leasing the parcels would lead to some type of development that would have indirect effects on global climate through GHG emissions. However, those effects on global climate change cannot be determined. It is unknown whether the petroleum resources specific to these leases in the Proposed Action are gas or oil or a combination thereof.

Oil and gas production in New Mexico is concentrated in the northwest corner, the San Juan Basin, and the southeast corner, the Permian Basin. Production in the San Juan Basin is mostly natural gas while production in the Permian Basin is mostly oil. Production statistics developed from EPA and New Mexico Oil Conservation Division for 2012 are shown in Table 5 for the United States, New Mexico, and for wells on federal leases in each basin.

Table 5. 2012 Oil and Gas Production (Petroleum Recovery Research Center, 2014)

	Oil Barrels (bbl)	Percent of US Total	Gas (MMcf)	Percent of US Total
United States	2,364,835,000	100	25,307,949	100
New Mexico	85,045,000	3.60	1,215,773	4.80
Federal leases in New Mexico	42,109,245	1.80	776,698	3.07
San Juan Basin	584,828	0.02	580,474	2.29
Permian Basin	41,524,417	1.80	70,329	0.03

In order to estimate the contribution of Federal oil and gas leases to greenhouse gases in New Mexico it is assumed that the percentage of total US production is comparable to the percentage of total emissions. Therefore, emissions are estimated based on production starting with total emissions for the United States from EPA's *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2010* (EPA, 2012b), and applying production percentages to estimate emissions for the Permian Basin. It is understood that this is a rather simplistic technique and assumes similar emissions in basins that may have very different characteristics and operational procedures, which could be reflected in total emissions. This assumption is adequate for this level of analysis due to the unknown factors associated with eventual exploration and development of the leases. However, the emissions estimates derived in this way, while not precise, will give some insight into the order of magnitude of emissions from federal oil and gas leases administered by the BLM and allow for comparison with other sources in a broad sense (Table 6).

Table 6. 2012 Oil and Gas Field Production Emissions (US Environmental Protection Agency, 2014)

	Oil		Gas		Total Oil and Gas Production	Percent US Total GHG missions
(Metric Tons CO ₂ e)	CO ₂	CH ₄	CO ₂	CH ₄		
United States	300,000	31,000,000	10,800,000	53,400,000	95,500,000	1.47
New Mexico	10,800	1,116,000	518,400	2,563,200	4,208,400	0.07
Federal leases in New Mexico	5,400	558,000	331,560	1,639,380	2,534,340	0.04
San Juan Basin	60	6,200	247,320	1,222,860	1,476,440	0.02
Permian Basin	5,400	558,000	3,240	16,020	582,660	0.01

Table 7 shows the estimated greenhouse gas emissions for oil and gas field production for the US, New Mexico, and Federal leases by basin. Because oil and gas leaves the custody and jurisdiction of the BLM after the production phase and before processing or refining, only emissions from the production phase are considered here. It should also be remembered that following EPA protocols, these numbers do not include fossil fuel combustion which would include such things as truck traffic, pumping jack engines, compressor engines, and drill rig engines; nor does it include emissions from power plants that generate the electricity used at well sites and facilities. The estimates are only for operations, not for construction and reclamation of the facilities, which may have a higher portion of a projects GHG contribution. Note that units of Metric tons CO₂e have been used in the table above to avoid very small numbers. CO₂e is the concentration of CO₂ that would cause the same level of radiative forcing as a given type and concentration of greenhouse gas.

Table 7 also provides an estimate of direct emissions that occur during production of oil and gas. This phase of emissions represents a small fraction of overall emissions of CO₂e from the life cycle of oil and gas. For example, acquisition (drilling and development) for petroleum is responsible for only eight percent of the total CO₂e emissions, whereas transportation of the petroleum to refineries represents about 10 percent of the emissions, and final consumption as a transportation fuel represents fully 80 percent of emissions (U.S.DOE, NETL, 2008).

To estimate the potential emissions from the proposed lease sale, an estimate of emission per well is useful. To establish the exact number of Federal wells in the Permian Basin is

problematic due to the ongoing development of new wells, the abandonment of unproductive wells, land sales and exchanges, and incomplete or inaccurate data bases. CFO determined that the most transparent and publicly accessible method of estimating the number of active federal wells in the New Mexico portion of the Permian Basin was to utilize the BLM New Mexico GIS and the New Mexico Conservation Division ONGARD Data Search Page. ONGARD was searched for all Active, New, and Temporarily Abandoned wells in NM, then refined the search to include only Lea, Eddy, and Chavez counties (25,298), and finished the search by limiting the results to Federal wells (11,216).

Table 7. Potential Greenhouse Gas Emissions Resulting from Proposed Lease Sale (Referenced to Latest Available Estimates from 2012)

GHG Emission Source	Total Emissions (metric tons CO₂e annually)	Percent
Total U.S GHG Emission From All Souces	6,501,500,000	100
Total U.S. GHG Emissions From Oil and Gas Field Production	95,500,000	1.47
Total New Mexico Emissions From Oil and Gas Field Production	4,208,400	0.07
Total Federal Mineral Estate San Juan Basin Emissions From Oil and Gas Field Production (14,995 wells)	702,815	0.01
Total Federal Mineral Estate Permian Basin Emissions From Oil and Gas Field Production (12,443 wells)	583,203	0.009
Total Potential GHG Emissions From Oil & Gas Field Production at Full Development--Proposed Action (401 Wells)	18,795	0.0003

Table 7 estimates that the total emissions from Federal leases in the Permian in 2012 were 583,203 metric tons CO₂e. Therefore, the estimate of emissions per well is 46.87 metric tons CO₂e annually. For the proposed action, the maximum number of wells that could be drilled on the 36 parcels would be 401. In the event that full development occurs and all wells were individually drilled, the maximum emissions resulting from the proposed action would be 18,795 metric tons CO₂e per year (or 0.0003 percent of total annual metric tons of CO₂e).

Potential Mitigation

The EPA's inventory data describes "Natural Gas Systems" and "Petroleum Systems" as the two major categories of total US sources of GHG gas emissions. The inventory identifies the contributions of natural gas and petroleum systems to total CO₂ and CH₄ emissions (natural gas and petroleum systems do not produce noteworthy amounts of any of the other greenhouse gases). Within the larger category of "Natural Gas Systems", the EPA identifies emissions occurring during distinct stages of operation, including field production, processing, transmission and storage, and distribution. "Petroleum Systems" sub-activities include production field operations, crude oil transportation and crude oil refining. Within the two categories, the BLM has authority to regulate only those field production operations that are related to oil and gas measurement and prevention of waste (via leaks, spills and unauthorized flaring and venting).

Between 2008 and 2012, methane and carbon dioxide emissions from oil production have increased nationally due to increases in domestic oil production. Between 2006 and 2012, methane emissions from natural gas production declined significantly due to improved practices and the use of green completions with hydraulic fracturing. However, during the same period, carbon monoxide emissions from natural gas production increased significantly due to increases

in flaring (U.S. Environmental Protection Agency, 2014). The CFO would work with industry to facilitate the use of the relevant BMPs for operations proposed on Federal mineral leases where such mitigation is consistent with agency policy.

4.3.3 Cultural Resources

While the act of leasing a parcel would produce no impacts, subsequent development of the lease could have impacts on archaeological resources. Required archaeological inventories would be conducted upon all subsequent actions that are expected to occur from the lease sale to avoid disturbing cultural resources.

Potential threats to cultural resources from leasing are variable and dependent upon the nature of the cultural resource and the nature of the proposed development. Effects normally include alterations to the physical integrity of a cultural resource. The greatest potential impact to cultural resources stems from the construction of associated lease related facilities such as pipelines, power lines, roads, and well locations. If a cultural resource is significant for other than its scientific information, effects may also include the introduction of audible, atmospheric, or visual elements that are out of character for the cultural site and diminish the integrity of those criteria that make the site significant.

A potential effect from the proposed action is the increase in human activity or access to the area with the increased potential of unauthorized removal or other alteration to cultural resources in the area. These impacts could include altering or diminishing the elements of a National Register eligible property and diminish an eligible property's National Register eligibility status. Conversely, cultural resource investigations associated with development potentially adds to our understanding of the prehistory/history of the area under investigation and discovery of sites that would otherwise remain undiscovered due to burial or omission during review inventories.

All lease parcels contain the Cultural Resource Lease Notice NM-LN-11.

Potential Mitigation

Specific mitigation measures, including, but not limited to, possible site avoidance or excavation and data recovery would have to be determined when site-specific development proposals are received. Provided that Class III cultural resource inventories are conducted as lease development takes place, and avoidance measures associated with the preservation of cultural resources are proposed and stipulated during development, there does not appear to be any adverse impacts to cultural resources from leasing. In the event that sites cannot be avoided, mitigating measures would be developed in consultation with Native American tribes that ascribe affiliation or historical relationships to those sites.

4.3.4 Native American Religious Concerns

The Proposed Action is not known to physically threaten any TCPs, prevent access to sacred sites, prevent the possession of sacred objects, or interfere or otherwise hinder the performance of traditional ceremonies and rituals pursuant to the American Indian Religious Freedom Act (AIRFA) or Executive Order Number 13007. The CFO consults with seven Native American tribes: the Hopi Tribe, Isleta Pueblo, Mescalero Apache, Ysleta del Sur Pueblo, Comanche

Nation, the Apache Tribe of Oklahoma, and the Kiowa Tribe. Consultation was initiated with a letter dated February 19, 2016. To date, only the Comanche Nation has responded, stating they had no concerns with the current lease sale.

There are currently no known remains that fall within the purview of the Native American Graves Protection and Repatriation Act (NAGPRA) or Archaeological Resources Protection Act (ARPA) that are threatened by leasing. Use of lease notice NM-11-LN would help ensure that new information is incorporated into lease development. Additional consultation may be initiated at the APD stage of development if BLM specialists determine it is necessary.

Potential Mitigation

No site-specific mitigation measures for Native American Religious Concerns have been recommended at this time for the parcels recommended to proceed for sale. All parcels recommended to proceed to sale would have the Cultural Resource Lease Notice NM-11-LN attached to the lease. In the event that lease development practices are found in the future to have an adverse effect on Native American TCPs, the BLM, in consultation with the affected tribe, would take action to mitigate or negate those effects. Measures include, but are not limited to physical barriers to protect resources, relocation of practices responsible for the adverse effects, or other treatments as appropriate.

To be in conformance with NAGPRA (Public Law 101-610), the terms and conditions of the lease should contain the following condition: In the event that the lease holder discovers or becomes aware of the presence of Native American human remains within the lease, they shall immediately notify the Bureau of Land Management in writing.

4.3.5 Paleontological Resources

While the act of leasing Federal minerals would produce no direct impacts to paleontological resources, subsequent development of a lease may produce impacts. Construction can directly impact fossil resources and newly built roads can open previously inaccessible areas to illegal collecting and vandalism of fossil resources. Scientifically noteworthy fossils and localities containing them are rare and not uniformly distributed throughout the geologic deposits. Loss of fossil resources or rare and scientifically important localities may have an unforeseen cumulative effect. Development could, however, increase the potential for discovering scientifically noteworthy fossil resources if the nature and significance of the paleontological material is recognized. Adequate measures would be applied to ensure proper treatment and recovery of fossil resources.

These areas can be identified by referring to detailed geologic maps on a case-by-case basis. Should construction activities reveal any new paleontological sites, construction would be delayed until salvage efforts are undertaken. Construction could also be relocated if the site were judged to have enough significance to warrant moving the activity.

Potential Mitigation

BLM may require inventory for paleontological resources within a PFYC 3-4. Should deposits be identified within an area of potential effect, there may be modifications to, or disapproval of, proposed activities that are likely to affect paleontological resources.

4.3.6 Water Resources

While the act of leasing Federal minerals would produce no direct impacts to water resources, subsequent development of a lease may produce impacts. Surface disturbance from the construction of well pads, access roads, pipelines, and utility lines can result in degradation of surface water and groundwater quality from non-point source pollution, including soil loss and increased erosion.

Potential causes of impacts to water resources from drilling operations include the loss of drilling fluids, which sometimes contain heavy metals and other chemicals, or cement. This may pollute groundwater recharge areas and adversely impact water quality. Additionally, cementing operations could plug some of the underground drainages and restrict groundwater flow, thereby reducing the recharge quality and quantity of springs, resurgences, and water tables and reducing the natural flow from seeps, springs, and water wells. In addition, drilling an oil or gas well may require large quantities of water, especially when drilling through porous and permeable formations. Fresh water is a scarce resource in the CFO and depending on the source used, natural flow from seeps, springs, and water wells could be reduced.

Potential causes of impacts from well production include the introduction of hydrocarbons or other chemicals into underground drainages and recharge areas as a result of leaks or spills from well casings, storage tanks, mud pits, pipelines, or other production facilities. This may also degrade water quality.

Contamination of groundwater could occur without adequate cementing and casing of the proposed well bore. Casing specifications are designed and submitted to the BLM. The BLM independently verifies the casing program, and the installation of the casing and cementing operations are witnessed by certified Petroleum Engineering Technicians. Surface casing setting depth is determined by regulation. Adherence to APD COAs and other design measures would minimize potential effects to groundwater quality.

Hydraulic fracturing of Wells on BLM Lands

Potential impacts from the hydraulic fracturing of a well could arise from the chemicals that are used at the well pad location. If the well location was within close proximity to water sources, a potential impact to the waters could arise due to the chemicals being used during the hydraulic fracturing process. A more site specific analysis would take place during the APD review and subsequent NEPA analysis. There also is the potential for illegal dumping of waste products into fresh water pits used during the hydraulic fracturing purposes. If this illegal dumping was to occur there is the potential to impact migratory birds and other wildlife species.

The hydraulic fracturing of a well can potentially result in an increase of surface disturbances associated with equipment needed to complete the process. Part of the increase in surface disturbance is associated with a location within the lease used to place a centrally located frack pond or frack tank farm. Frack ponds are used to hold fresh water as part of the hydraulic fracturing process, and frack tank farms are used to hold fresh water in enclosed tanks, as part of the hydraulic fracturing process.

The water used for hydraulic fracturing in the CFO generally comes from permitted groundwater wells. Because large volumes of water are needed for hydraulic fracturing, the use of

groundwater for this purpose might contribute to the drawdown of groundwater aquifer levels. Groundwater use is permitted and managed by the New Mexico Office of the State Engineer, and these water rights have already been designated. In addition, the use of water for hydraulic fracturing is one of many uses of groundwater in the CFO. Other uses include irrigation, industrial mining operations, and domestic and livestock use.

Fourteen of the proposed parcels are within or near (<200 meters) known playas, streams, rivers, floodplains, springs, seeps, or dirt tanks, as described in Section 3.6. The magnitude of any of the described impacts to water resources would depend on the proximity of the disturbance to the water resource; slope, aspect and gradient; degree and area of soil disturbance; soil character; duration and time within which the activity would or did occur; and the timely implementation and success or failure of mitigation measures.

Potential Mitigation

Specific mitigation measures for the protection of surface and ground water would be addressed at the APD stage. Mitigation may include the use of a plastic-lined reserve pits, steel tanks or steel tank closed systems, or containment berms to reduce or eliminate seepage of drilling fluid and hydrofrac flow back water into the soil, surface water, and groundwater.

Both surface and usable ground water can be protected from drilling fluids and salt water zones by setting surface casing to isolate the aquifers from the rest of the borehole environment.

4.3.7 Wetlands, Riparian and Floodplains

While the act of leasing Federal minerals would produce no direct impacts to wetlands, riparian areas, and floodplains, subsequent development of a lease may produce impacts. However, no adverse impacts are expected for wetlands, floodplains, or riparian areas, as stipulations for a minimum 200-meter buffer from the edge of the floodplain or wetland would be applied to an APD. By moving pads, roads, and rights-of-way away from the edge of wetland or riparian areas, the values these areas provide would be protected.

The risk of hydrocarbon spills or seepage from any pits containing hydrocarbons or brines could threaten water resources. Poor cement jobs or corroded or bad casing or tubing during production operations can allow hydrocarbons to enter potentially viable aquifers. The magnitude of these impacts would depend on the type of spill or seepage; proximity of the spill to the resource; slope, aspect and gradient; degree and area of disturbance; soil character; duration and time within which the spill occur; and the timely implementation and success or failure of clean up and mitigation measures. These events can propagate downstream and damage or destroy these fragile environments which contain lush grasses, aquatic birds and their nesting environment, and aquatic life such as fishes and crustaceans.

Potential Mitigation

The mitigation measures addressed below are meant to protect wetlands and riparian areas of concern. Surface disturbing activities would be moved up to 200 meters from wetlands, floodplains, and riparian areas. Some lease parcels may have unidentified windmills for livestock watering purposes and would require a COA for a 200-meter buffer at the APD stage. Site-specific COAs would be incorporated at the APD stage of development.

4.3.8 Soils

While the act of leasing a tract would produce no direct impacts, subsequent development of the lease would physically disturb the topsoil and would expose the substratum soil on subsequent project areas. Direct impacts resulting from the oil and gas construction of well pads, access roads, and reserve pits include removal of vegetation, exposure of the soil, mixing of horizons, compaction, loss of top soil productivity, and susceptibility to wind and water erosion. Wind erosion would be expected to be a minor contributor to soil erosion with the possible exception of dust from vehicle traffic. These impacts could result in increased indirect impacts such as runoff, erosion, and off-site sedimentation. Activities that could cause these types of indirect impacts include construction and operation of well sites, access roads, gas pipelines, and facilities.

Contamination of soil from drilling and production wastes mixed into soil or spilled on the soil surfaces could cause a long-term reduction in site productivity. Some of these impacts can be reduced or avoided through proper design, construction and maintenance, and implementation of BMPs.

Additional soil impacts associated with lease development would occur when heavy precipitation causes water erosion damage. When water saturated segment(s) on the access road become impassable, vehicles may still be driven over the road. Consequently, deep tire ruts would develop. Where impassable segments are created from deep rutting, unauthorized driving may occur outside the designated route of access roads.

Potential impacts from the hydraulic fracturing of a well could arise from the chemicals that are used at the well pad location (see Appendix 2). If chemicals being used during the hydraulic fracturing process were spilled on the location, the potential to pollute or change the soil chemistry could exist. A more site specific analysis would take place during the APD review and subsequent NEPA analysis. There also is the additional surface disturbance to the soils associated with the increase in required footprint for hydraulic fracturing equipment.

Parcels -001, -004, -005, -010, -012, -015, -017, -026, -027, -028, -029, -035, and -036 contain fragile soils or steep slopes. These soils are more susceptible to impacts from any surface disturbances and can be more difficult to mitigate the impacts and successfully complete interim and final reclamation. These locations are taken into consideration when APDs are submitted, and when possible, moved off of the fragile soils or steep slopes. If relocation is not possible, site-specific mitigation would be added to minimize the impacts to the soil resource.

Potential Mitigation

The operator would stockpile the topsoil from the surface of well pads in shallow rows which would be used for surface reclamation of the well pads. The impact to the soil would be remedied upon reclamation of well pads when the stockpiled soil that was specifically conserved to establish a seed bed is spread over well pads and vegetation re-establishes.

Reserve pits would be re-contoured and reseeded. Upon abandonment of wells, or when access roads are no longer in service, the Authorized Officer would issue instructions and orders for surface reclamation of the disturbed areas.

During the life of the development, all disturbed areas not needed for active support of production operations should undergo “interim” reclamation in order to minimize the environmental impacts of development on other resources and uses. Earthwork for interim and final reclamation must be completed within six months of well completion or well plugging (weather permitting).

The use of a plastic-lined reserve pits would reduce or eliminate seepage of drilling fluid into the soil. The use of steel tanks or closed systems would reduce or eliminate seepage of drilling fluid into the soil. Spills or produced fluids (e.g., saltwater, oil, or condensate in the event of a breach, overflow, or spill from storage tanks) could result in contamination of the soils onsite or offsite.

Road construction requirements and regular maintenance would alleviate potential impacts to access roads from water erosion damage. For the purpose of protecting slopes or fragile soils surface disturbance would not be allowed on slopes over 30 percent.

4.3.9 Vegetation

While the act of leasing Federal minerals would produce no direct impacts to vegetation, subsequent development of a lease may produce impacts. Vegetation would be lost within the construction areas of pads, roads, and rights-of-way. Those areas covered in caliche, such as pads and roads, would have no vegetation for the life of the well. Rights-of-way could revegetate in one to two years with proper reclamation and adequate precipitation. Poor reclamation practices followed by inadequate precipitation over several growing seasons could result in loss of vegetative cover, leading to weed invasion and deterioration of native vegetation.

Impacts to vegetation depends on development. These acres would produce no vegetation because of caliche covered surfaces with each well in production. These acres should be in adequate vegetative cover in three to five growing seasons if proper reclamation procedures are followed and adequate precipitation is received after the well is plugged.

Potential impacts from the hydraulic fracturing of a well could arise from the chemicals that are used at the well pad location (see Appendix 2). If chemicals being used during the hydraulic fracturing process were spilled on the location or nearby vegetation it could potentially pollute or damage the nearby vegetation. A more site specific analysis would take place during the APD review and subsequent NEPA analysis.

Potential Mitigation

Mitigation would be addressed at the site-specific APD stage of exploration and development. Mitigation could potentially include re-vegetation with native plant species, soil enhancement practices, direct live haul of soil material for seed bank re-vegetation, reduction of livestock grazing, fencing of reclaimed areas, and the use of seeding strategies consisting of native grasses, forbs, and shrubs.

4.3.10 Noxious Weeds

While the act of leasing Federal minerals would produce no direct impacts to noxious weeds, subsequent development of a lease may produce impacts. Any surface disturbance could

establish new populations of invasive nonnative species, although the probability of this happening cannot be predicted using existing information. At the APD stage, BLM requirements for use of weed control strategies would minimize the potential for the spread of these species.

Potential Mitigation

New infestations of noxious weeds would be prevented or kept to small localized areas on drill pads; however, as current populations of noxious weeds do exist, surface disturbance associated with lease development could allow the populations to increase in size or spread to other sites. Weed seeds may be picked up on the tires of vehicles and then spread across the landscape. If noxious weeds are detected, abatement measures would be implemented. These include weed inventory surveys, weed monitoring programs, and a spraying program.

The spraying program would reduce or eliminate existing populations, control the spread of current populations, or prevent the establishment of new populations. Measures to ensure the prevention of the spread of noxious weeds would be in place, such as the washing of vehicles before leaving infested areas. The CFO works closely with the surrounding communities and the oil and gas industry to monitor and chemically treat heavily infested areas before habitat areas are invaded.

Any APDs submitted and subsequently approved would have the following COA attached: The operator would be held responsible if noxious weeds become established within the areas of operations. Weed control would be required on the disturbed land where noxious weeds exist, which includes the roads, pads, associated infrastructure, and adjacent land affected by the establishment of weeds due to the action. The operator must consult with the Authorized Officer for acceptable weed control methods, which include following BLM requirements and policies.

Impacts from the Proposed Action would be addressed with mitigation measures when site specific development proposals are received and would be incorporated as COAs.

4.3.11 Special Status Species

While the act of leasing Federal minerals would produce no direct impacts to special status species, subsequent development of a lease may produce impacts. Impacts could result from increased habitat fragmentation, noise, or other disturbance during development. In addition, special status species may be disturbed while hydraulic fracturing or other completion and stimulation operations are occurring, as these activities involve many vehicles, heavy equipment, and a workover rig. These impacts would be limited to the timeframe during which drilling operations and hydraulic fracturing occurring, typically several weeks.

Dune Sagebrush Lizard

If dune sagebrush lizards are present impacts to dune sagebrush lizards, if any, would be minimal because parcels that contain suitable habitat would contain a stipulation requiring a buffer up to 200 meters. Construction in sand dune complexes that are suitable habitat or occupied habitat could reduce the size of habitat available to the species or extirpate sand dune lizard populations from the area. This could be avoided as long as infrastructure associated with oil and gas development is moved out of occupied or suitable sand dune lizard habitat.

Parcels -007 and -017 are located within potentially suitable habitat for the dune sagebrush lizard. Lease stipulations have been attached to these parcels which require a survey and plan of development (POD). No surface disturbance would be allowed within up to 200 meters of suitable habitat associated with occupied habitat areas identified through field review.

Potential Mitigation

Parcels nominated in the Special Status Species RMPA areas are reviewed by the State Director for concurrence based on the Record of Decision and Approved Resource Management Plan Amendment of April 2008. The BLM would continue to require oil and gas lessees to operate in a manner that would minimize adverse impacts to wildlife and special status species. To that end, the BLM would continue to apply reasonable measures to all oil and gas activities.

Leasing with requirements for PODs or COAs to ensure orderly development within a minimum of surface impact in lesser prairie-chicken and dune sagebrush lizard habitats would be considered on a case-by-case basis, providing impacts from exploration and development would not cause unnecessary or undue impact to efforts to restore habitat. A POD would be required for development of these lease areas.

4.3.12 Threatened and Endangered Species

Lesser Prairie-Chicken

Development of leases with suitable habitat could potentially impact local populations of LPC. Construction of the location and around-the-clock noise generated from drilling could impact the LPC by reducing the establishment of seasonal "booming grounds" or leks, thus possibly reducing reproductive success in the species. It is believed that the noise generated by drilling rigs or unmuffled propane- or diesel-operated pumpjack motors could mask the booming of the male prairie-chicken. Female LPCs, unable to hear the males, would not arrive at the booming ground, causing courtship interaction and reproduction to decrease. Decreased reproduction and the loss of recruitment into the local population would result in an absence of younger males to replace mature males once they expire, eventually causing the lek to disband and become inactive. Additionally, habitat fragmentation caused by development could decrease the habitat available for nesting, brooding and feeding activities.

Sixteen parcels have the LPC controlled surface use stipulation attached which prohibits drilling for oil and gas and 3-D geophysical exploration activities between March 1 and June 15 in LPC habitat. During that same period noise producing operations would be prohibited between 3:00 am and 9:00 am. Furthermore, no new drilling would be allowed within 200 meters of a lek and exhaust noise from pump jack engines cannot exceed 75dB when measured 30 feet from the noise source. By requiring lessees to comply with these stipulation, impacts to LPC are minimized. USFWS concurred with the CFO wildlife biologist's "may affect, not likely to adversely affect" determination for the 16 proposed lease parcels.

The additional parcels of the proposed action would have no effect on LPC as these parcels are not in or near potential or suitable habitat.

Potential Mitigation

The Pecos District Special Status Species Resource Management Plan Amendment of 2008

affords LPCs specific protection measures pertaining to new drilling. The protections include a stipulation on new drilling during the breeding season (between March 1 and June 15) and a restriction on other production activities, such as land survey and construction, between the hours of 3:00 a.m. and 9:00 a.m. These restrictions apply to areas that contain lesser prairie-chicken habitat consisting of tall bunchgrasses (*Andropogon* spp., *Sporobolus* spp.), sand sagebrush (*Artemisia filifolia*), and typically shinny oak (*Quercus havardii*). Exceptions to the stipulations would be considered under the criteria set forth in the special status species RMPA.

In addition, raptors have been observed using plugged and abandoned well markers as perches. Artificial perches may increase raptor presences in a given area. Furthermore, artificial perches may provide strategically located vantage points and may improve the hunting efficiency of raptors. In order to improve the probability of maintaining a stable LPC population, a low-profile COA for plugged and abandoned well markers would be attached to all APDs located within LPC habitat. The well marker would be approximately two inches above ground level and contain the operator's name, lease name, well number, and location, including unit letter, section, township, and range. This information would be welded, stamped, or otherwise permanently engraved into the metal of the marker.

In New Mexico, a combination Candidate Conservation Agreement (CCA) and Candidate Conservation Agreement with Assurances (CCAA) are in place and continue to be established covering the LPC. In 2008 the USFWS, BLM, and the Center of Excellence in Hazardous Materials Management (CEHMM) partnered to develop a CCA and CCAA for the conservation of the LPC. These agreements allow oil and gas producers and the ranching industry to participate in the conservation measures outlined in the agreement, while ensuring that their activities can continue if the LPC is listed under the ESA. The CCA covers activities on federal lands, and the CCAA covers activities on non-federal lands. Participating cooperators from the oil and gas industry follow conservation measures at each drill site, and also pay into a conservation fund that is used to restore habitat for the lesser-prairie chicken. CEHMM, a New Mexico-based 501(c)(3) organization whose mandate includes conservation, holds the permit for the CCAA and administers conservation programs in the CCA and CCAA. As of October 1, 2012, 30 oil and gas companies are enrolled in the CCAA for a total of 816,000 acres (the participating Federal agency in this case is the BLM). In addition, 41 New Mexico ranchers have enrolled a combined 1.5 million acres of rangeland in the CCAA and the New Mexico State Land Office has enrolled 248,000 acres in the CCAA.

PODs would be required for the development of all proposed action leases described above.

4.3.13 Wildlife

While the act of leasing Federal minerals would produce no direct impacts to wildlife, subsequent development of a lease may produce impacts. Impacts could result from increased habitat fragmentation, noise, or other disturbance during development. The severity of effects depends on the sensitivity of the species affected. The species present in these areas tend to vacate traditional habitats under continued and increasing pressure from petroleum activities. Additional wells would increase the risk to wildlife in the developing area as a result of noise and visual impacts from compressor stations, an increased number of operating pumpjacks,

powerlines (which can hum in the wind), drilling rigs, and increased vehicular traffic, among others.

In addition, wildlife may be disturbed while hydraulic fracturing or other completion and stimulation operations are occurring, as these activities involve many vehicles, heavy equipment, and a workover rig. These impacts would be limited to the timeframe during which drilling operations and hydraulic fracturing occur, typically several weeks. This could cause wildlife to avoid these areas, including wildlife watering units, and relocate to other less-developed areas. Disturbance to the surface itself could potentially degrade or fragment habitat to such a degree that it may become unusable for certain species.

Other forms of surface disturbance could take place on developing leases, such as the installation of caliche pits, the addition of oil and gas field infrastructure such as powerlines, pipelines, tank batteries or other storage facilities, and the construction of new roads that could fragment habitat and increase the risk of collision between vehicles and wildlife. Effects on raptor nests or heronries could result in a reduction of nesting habitat for raptors or herons, thus reducing the likelihood of sustaining the local population.

The effects of human-associated disturbance is a primary threat to raptor populations. The construction and development associated with oil and gas exploration and development may adversely affect potential nest sites and associated foraging area that support the pairs nesting effort. The specific effects and tolerance limits to disturbance on raptors vary among and within raptor species. This is due to the broad range of direct and indirect human-associated impacts and the fluctuating levels of sensitivity for individual raptors depending on life stage and time of year. Behavioral data suggests that adults that become sensitized to human presence are less than normally attentive to their young which can reduce fledging success. Furthermore, behavioral data suggests that raptors have the tendency to shift or expand their home ranges or move to new areas (Anderson et al. 1990). Disruption of foraging areas can result in lowered hunting success, increased intraspecific encounters, and reduced food intake (Anderson 1984). Raptors displaced from foraging areas may have increased energy expenditures and less time available for other activities and their productivity could be adversely affected (Stalmaster and Kaiser 1997). The noise caused by pump jack engines could cause potential abandonment of nests or a shift or expansion of home range. Adherence to the COAs and mitigation measures is critical for the protection of this resource.

In order to minimize human disturbance, spatial and temporal buffer zones can protect raptors during periods of extreme sensitivity. Raptors may tolerate considerable noise close to their nests if they are familiar with it, especially if humans are not visible or otherwise obviously associated with it (Schueck et al. 2001). Potentially, if a disturbance is periodic and ongoing when adults first arrive at their nests, and are not perceived as threatening, raptors may habituate to them.

Potential Mitigation

Impacts would be analyzed on a site specific basis prior to development. Site-specific COAs or BMPs may be developed at the APD stage to further mitigate direct and indirect effects. The BLM would continue to require oil and gas lessees to operate in a manner that would minimize adverse impacts to wildlife. To that end, the BLM would continue to apply reasonable measures to all oil and gas activities.

4.3.14 Range

While the act of leasing Federal minerals would produce no direct impacts to livestock grazing, subsequent development of a lease may produce impacts.

The construction of pads, pits, roads, and rights-of-way would cause forage to be lost on portions of 14 grazing allotments. On average, the grazing of vegetation by livestock takes approximately six acres of vegetation per AUM, which is the amount of forage needed to support one cow for one month. In total, the proposed action could result in the loss of 370 acres. These totals for losses of available forage are based on the amount of Federal mineral estate in correlation with the amount of Federal surface used to determine the amount of available forage within each individual grazing allotment. Even though there may be a Federal grazing allotment, it could be predominately made up of State lands. The locations or placement of well pads and infrastructure on state lands would not create a impact to the amount of available forage calculated for Federal acreage within the grazing allotment. However there would be a loss of available forage within the State portion of the grazing allotment.

There are occasional livestock injuries or deaths due to accidents such as collisions with vehicles, falls into mud pits or other excavations, or ingestions of plastic or other materials present at work sites. Construction activities can damage range improvements such as fences and pipelines. These impacts make day-to-day livestock management actions more difficult.

Potential impacts from the hydraulic fracturing of a well could impact grazing allotments if the grazing permittee chose to sell fresh water to the operator of an oil and gas well and they did not have enough water present to water their livestock. A more site specific analysis would take place during the APD review and subsequent NEPA analysis.

Proposed Action

The proposed action covers all or parts of fourteen grazing allotments: Pierce Canyon, Twin Wells, Swag, Halfway, Goedeke Grazing Cell, Sam Simon Swale, Red Tank, Medlin Wells, Monument Draw, Javelina Basin, Clayton Basin, Andrews Flat, Pecos River, and Harroun Lake. The potential surface disturbance for each of the affected allotments is as follows:

Allotment Name	Total (acres)
Pierce Canyon	11
Twin Wells	39
Swag	31
Halfway	9
Goedeke Grazing Cell	9
Sam Simon Swale	9
Red Tank	26
Medlin Wells	182
Monument Draw	18
Javelina Basin	9
Clayton Basin	4
Andrews Flat	15
Pecos River	4
Harroun Lake	4
Total	370

Potential Mitigation

Mitigation would be deferred until the site-specific APD stage of development. The BLM currently consults grazing permittees on a site-by-site basis as part of the APD process. BMPs would be incorporated into COAs.

4.3.15 Visual Resource Management

While the act of leasing Federal minerals would produce no direct impacts to visual resources, subsequent development of a lease may produce impacts. Oil and gas development can create many visual scars on the landscape. Development can create contrast to the landscape's natural form, line, color, and texture. Pads, tanks, roads, powerlines, and pipelines introduce unnatural forms into the landscape. Clearing for pads, roads, and pipelines create unnatural color, line and texture changes. Tanks and poles add vertical trends to generally flat landscapes. The more prominent these visual contrasts, the more a project would stand out and distract from the natural view of the landscape. The more unnatural distractions added to a landscape, the more unpleasing the landscape would look.

Each surface development visually impacts the landscape. Each project may meet or exceed the area's VRM objectives; however, as an entire oil field is developed, small visual impacts would accumulate to create harsh scars on the landscape. The cumulative effects would degrade the visual esthetics and public's appreciation for their surrounding environment. To avoid this result, all projects (regardless of VRM class) should be hidden, masked, and reclaimed as best as practicable with BMPs and COAs.

The following lease parcels are within Class III Objectives: -004 and -005. The objective of this class is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but

should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.

Because all other parcels are located with a VRM Class IV area, where the level of change to the characteristic landscape can be high, the level of visual impact from oil and gas development would not vary from the existing surrounding environment.

Potential Mitigation

Mitigation measures to reduce impacts of development and maintain Visual Resource Class Objectives would include landform considerations such as moving locations to areas with less slope, changing road width and grade, changing alignment to follow existing grades, and prohibiting dumping of excess material on downhill slopes. Earthwork COAs may include rounding or warping slopes, retaining rocks, trees and drainage, adding mulch, hydromulch, or topsoil, shaping cuts and fills to appear as natural forms, cutting rock areas so forms are irregular, designing to take advantage of natural screens (i.e., vegetation, land forms), and grass seeding of cuts and fills.

Topography considerations may require locating projects away from prominent topographic features and designing projects to blend with topographic forms in shape and placement. Additional COAs for retaining vegetation may include using retaining walls on fill slopes, reducing surface disturbance, protecting roots from damage during excavations, mulching cleared areas, controlling planting times, furrowing slopes, planting holes on cut and fill slopes, choosing native plant species, stockpiling and reusing topsoil, fertilizing, mulching, and watering vegetation, utilizing existing roads, limiting work within construction area, selecting type of equipment to be used, and minimizing clearing size.

Permanent structures are impacts for the life of the project. To minimize the number of visible structures, COAs would be applied requiring use of earth-tone paints and stains and natural stone surfaces, burying all or part of the structure, selecting paint finishes with low levels of reflectivity (i.e., flat), redesigning structures to blend with surroundings, and relocating structures.

Interim reclamation measures for the working life of the pad may be implemented to reduce visual impacts, such as partial revegetation of the pad after initial drilling is complete to allow only necessary surface use and access requirements. COAs would be added to the site-specific APD stage of development.

COAs may require utilities and rights-of-way related to the development of the proposed lease parcels to be stipulated by making crossings at right angles of corridors, setting structures a maximum distance from the crossing, leaving vegetation along the roadside, minimizing viewing time, and utilizing natural screening.

4.3.16 Recreation

While the act of leasing Federal minerals would produce no direct impacts to recreation, subsequent development of a lease may produce impacts. Potential impacts could affect dispersed recreation activities, such as big game hunting in certain pastures of individual parcels,

but these effects cannot be determined until site-specific development proposals are received at the APD stage.

Additional wells would reduce the acreage available for recreation in open space on public land. Dispersed recreation activities, such as off-road driving, hunting, and hiking could be impacted by increased traffic, visual intrusions, noise, trash, and other related results of oil and gas development. Additionally, aboveground facilities fragment open space and reduce the natural setting of areas. Some recreation pursuits could be limited by additional hazards created by facilities and infrastructure related to development.

In addition, any recreationists in the area may be disturbed while hydraulic fracturing or other completion and stimulation operations are occurring, as these activities involve many vehicles, heavy equipment, and a workover rig. These impacts would be limited to the timeframe during which drilling operations and hydraulic fracturing occurs, typically several weeks (see Appendix 2).

Potential Mitigation

Mitigations for impacts to recreation would be determined when specific sites for development are determined. Mitigation measures may include moving locations, increased safety precautions during construction, relocating existing trails, reducing visual impacts, implementing noise control devices on facilities, and co-locating facilities and corridors to reduce surface disturbance.

4.3.17 Cave/Karst

While the act of leasing Federal minerals would produce no direct impacts to cave or karst resources, subsequent development of a lease may produce impacts. Cave and karst features provide direct conduits leading to groundwater. These conduits can quickly transport surface and subsurface contaminants directly into underground water systems and freshwater aquifers without filtration or biodegradation as a result of the development of oil and gas leases. In addition, contaminants spilled or leaked into or onto cave and karst zone surfaces and sub-surfaces may lead directly to the disruption, displacement, or extermination of cave species and critical biological processes. In extreme or rare cases, a buildup of hydrocarbons in cave systems due to surface leaks or spills could potentially cause underground ignitions or asphyxiation of wildlife or humans within the cave.

In cave and karst terrains, rainfall and surface runoff is directly channeled into natural underground water systems and aquifers. Changes in geologic formation integrity, runoff quantity and quality, drainage course, rainfall percolation factors, vegetation, surface contour, and other surface factors can negatively impact cave ecosystems and aquifer recharge processes. Blasting, heavy vibrations, and focusing of surface drainages can lead to slow subsidence, sudden collapse of subsurface voids, or cave ecosystem damage.

The construction of roads, pipelines, well pads, and utilities can impact bedrock integrity and reroute, impede, focus, or erode natural surface drainage systems. Increased silting and sedimentation from construction can plug downstream sinkholes, caves, springs, and other components of aquifer recharge systems and result in adverse impacts to aquifer quality and cave

environments. Any contaminants released into the environment during or after construction can impact aquifers and cave systems. A possibility exists for slow subsidence or sudden surface collapse during construction operations due to collapse of underlying cave passages and voids. This would cause associated safety hazards to the operator and the potential for increased environmental impact. Subsidence processes can be triggered by blasting, intense vibrations, rerouting of surface drainages, focusing of surface drainage, and general surface disturbance.

Blasting fractures in bedrock can serve as direct conduits for transfer of contaminants into cave and groundwater systems. Blasting also creates an expanded volume of rock rubble that cannot be reclaimed to natural contours, soil condition, or native vegetative condition. As such, surface and subsurface disruptions from blasting procedures can lead to permanent changes in vegetation, rainfall percolation, silting and erosion factors, aquifer recharge, freshwater quality, and can increase the risk of contaminant migration from drilling and production facilities built atop the blast area.

During drilling, previously unknown cave and karst features could be encountered. If a void is encountered while drilling and a loss of circulation occurs, lost drilling fluids can directly contaminate groundwater recharge areas, aquifers, and groundwater quality. Drilling operations can also lead to sudden collapse of underground voids. Cementing operations may plug or alter groundwater flow, potentially reducing the water quantity at springs and water wells. Inadequate subsurface cementing, casing, and cave and aquifer protection measures can lead to the migration of oil, gas, drilling fluids, and produced saltwater into cave systems and freshwater aquifers.

Potential impacts are more likely in areas with a high or medium potential for cave and karst features and systems, including parcels -001, -002, -003, -004, -005, and -011. Stipulation SENM-S-21 is attached to these parcels, which prohibits surface occupancy within 200 meters of any known cave or karst feature or system. Attaching this stipulation would minimize any potential impacts to the resource.

All remaining parcels are located within a low cave and karst zone and are likely to have a low potential for impacting the resource. However, due to incomplete cave and karst data, there may be potential for cave and karst impacts in these remaining parcels.

Potential Mitigation

Potential mitigations that could be developed during the APD and lease development stages may include: changes in drilling operations, special casing and cementing programs, modification in surface activities, cave and karst avoidance, or other reasonable measures.

4.3.18 Socioeconomics and Environmental Justice

While the act of leasing Federal minerals itself would result in no social impacts, subsequent development of a lease may generate impacts to people living near or using the area in the vicinity of the lease. Oil and gas exploration, drilling, or production could create a disruption to these people due to increased traffic and traffic delays, air pollution, noise and visual impacts. This would be especially noticeable in rural areas where oil and gas development has historically been minimal. The amount of disruption would depend on the activity affected, traffic patterns

within the area, noise levels, length of time, and season these activities occurred. In addition, any nearby residents may be disturbed while hydraulic fracturing or other completion and stimulation operations are occurring (see Appendix 2), as these activities involve many vehicles, heavy equipment, and a workover rig. These impacts would be limited to the period of time during which drilling operations and hydraulic fracturing occurs, typically several weeks.

Creation of new access roads into an area could allow increased public access and exposure of private property to vandalism. For leases where the surface is privately owned and the subsurface is managed by the BLM, surface owner agreements, standard lease stipulations, and BMPs would address many of the concerns of private surface owners.

Employment and associated population increases would be more likely to occur in the larger communities where the social effects would be less noticeable. Any new employment and population would probably be welcomed in the very small communities that are currently losing population. There would also be an increase in revenues that accrue to the counties where the production occurs. Depending on where production actually occurs, these revenues would benefit any receiving county but would be more noticeable in counties with smaller populations and lower current property and tax revenue.

Issuing any or all of these leases has no direct affects on employment in the region. Employment in the industry is directly affected by the market price for the commodities (crude oil and natural gas). High prices during the past five years has increased employment in the region. This in turn has increased the population in the area, placing stress on housing, schools, and emergency services in Chaves, Eddy, and Lea Counties. As the commodity prices fall, the easing of this stress would be expected.

Potential Mitigation

No mitigation would be required as a result of this proposed action.

4.3.19 Potash Resources

Potential impacts of drilling operations to potash resources could include migration of hydrocarbons through permeable formations or fractures within the formations that might provide a conduit to mine workings from improperly cased wells. Furthermore, potassium reserves could be lost because mine workings must leave a support pillar of sufficient size around well bores in order to prevent damaging subsidence. Proposed projects can be expected to be relocated to minimize impacts to potash resources while allowing drainage of remote areas within the potash enclave.

Parcels -003, -007, and -010 have the parcel boundary located within the R-111-P Boundary also known as the KPLA. Parcel -006 is located within the 2012 Secretary Potash Area. These parcels would require special casing design to protect the salt from objective oil and gas formations below.

While parcel -008 is not located within the KPLA or 2012 Secretary Potash Area, it is located over the planned Ochoa Potash Mine. The lease for parcel -008 would include a note to alert potential lessees of the need to communicate with the Intercontinental Potash Corporation.

Potential Mitigation

Lessees must comply with the 2012 Secretarial Potash Order. The Order is designed to promote the efficient development of oil, gas, and potash resources. Section 6 of the Order provides general provisions which must be followed to minimize conflict between the industries and ensure the safety of operations.

When the Authorized Officer determines that unitization is necessary for orderly oil and gas development and proper protection of potash deposits, no well shall be drilled for oil or gas except pursuant to a unit plan approved by the authorized officer.

The drilling or the abandonment of any well on said lease shall be done in accordance with applicable oil and gas operating regulations including such requirements as the Authorized Officer may prescribe as necessary to prevent the infiltration of oil, gas or water into formations containing potash deposits or into mines or workings being utilized in the extraction of such deposits.

5.0 Cumulative Impacts

The BLM NMSO manages approximately 41 million acres of Federal mineral estate. Of the 41 million acres, 35 million acres are available for oil and gas leasing (Table 8). Approximately 16 percent of the 35 million acres is currently leased (73 percent of the leases are in production and 63 percent of the lease acres are in production). The NMSO received 36 parcel nominations (13,876.08 acres) for consideration in the July 2016 Oil and Gas Lease Sale (Table 9). If these 36 parcels were leased, the percentage of Federal minerals leased would not significantly change (Table 10).

Table 8. Actual – Acres of Federal Minerals/Acres Available/Acres Leased

State	Federal Oil and Gas Mineral Ownership	Acres Available	Acres Leased	Percent Leased
KS	744,000	614,586	120,405	20%
NM	34,774,457	29,751,242	4,640,312	16%
OK	1,998,932	1,668,132	286,883	17%
TX	3,404,298	3,013,207	417,282	14%
Total	40,921,687	35,047,167	5,464,882	16%

Table 9. Parcels Nominated & Offered in the July 2016 Oil and Gas Lease Sale

Field Office	No. of Nominated Parcels	Acres of Nominated Parcels	No. of Parcels to be Offered	Acres of Parcels to be Offered
Carlsbad	36	13,876.080	36	13,876.080

Table 10. Foreseeable – Acres of Federal Minerals/Acres Available/Acres Leased

State	Federal Oil and Gas Mineral Ownership	Acres Available	Acres Leased	Percent Leased
KS	744,000	614,586	120,405	20%
NM	34,774,457	29,751,242	4,654,188	16%
OK	1,998,932	1,668,132	286,883	17%
TX	3,404,298	3,013,207	417,282	14%
Total	40,921,687	35,047,167	5,478,758	16%

Analysis of cumulative impacts for the Proposed Action for the development of oil and gas wells on public lands in the CFO is based on location of the parcels and the potential mineral estate that could be developed.

Effects on Air Resources

The following analysis of cumulative impacts of the Proposed Action on air quality would be limited to southeastern New Mexico. The cumulative impacts of GHG emissions and their relationship to climate change are evaluated at the national and global levels in the Air Resources Technical Report (USDI/BLM, 2014).

Effects of Other Past, Present, and Reasonably Foreseeable Actions on Air Resources

The primary activities that contribute to levels of air pollutant and GHG emissions in southeastern New Mexico are electricity generation stations, fossil fuel industries, and vehicle travel. The Air Resources Technical Report includes a description of the varied sources of national and regional emissions that are incorporated here to represent the past, present, and reasonably foreseeable impacts to air resources. It includes a summary of emissions on the national and regional scale by industry source. Sources that are considered to have notable contributions to air quality impacts and GHG emissions include electrical generating units, fossil fuel production (nationally and regionally) and transportation.

Cumulative Effects of the Proposed Action on Air Quality

The very small increase in emissions that could result from approval of the Proposed Action would not result in any county in southeastern New Mexico exceeding the NAAQS for any criteria pollutants. The applicable regulatory threshold for HAPs is the oil and gas industry National Emissions Standards for Hazardous Air Pollutants, which are currently under review by the EPA. The emissions from any wells drilled in the leased areas are not expected to impact the 8-hour average ozone concentrations, or any other criteria pollutants in southeastern New Mexico.

Climate Change

The very small increase in GHG emissions that could result from approval of the Proposed Action would not produce climate change impacts that differ from the No Action Alternative. This is because climate change is a global process that is impacted by the sum total of GHGs in the Earth's atmosphere. The incremental contribution to global GHGs from the Proposed Action cannot be translated into effects on climate change globally or in the area of this site-specific

action. It is currently not feasible to predict with certainty the net impacts from the Proposed Action on global or regional climate.

The Air Resources Technical Report discusses the relationship of past, present, and future predicted emissions to climate change and the limitations in predicting local and regional impacts related to emissions. It is currently not feasible to know with certainty the net impacts from particular emissions associated with activities on public lands.

Cultural Resources

Federal laws and regulations protect cultural resources on public lands, including archaeological sites and historic properties. Development activities must comply with these protective regulations, and BLM requires the completion of cultural resource inventories prior to surface disturbing activities. These inventories identify sites potentially eligible for inclusion in the National Register of Historic Places, sites on which the BLM has required past exploration, and development activities to avoid.

Because Class III cultural resource inventories must be completed, the potential for increased impacts on cultural artifacts would be minimized. By avoiding known cultural and historical sites during the layout of drill sites, access roads, pipeline corridors, and other realty actions, the potential for incremental increases in cumulative impacts would be avoided.

Completion of cultural resource inventories would have a beneficial cumulative impact on the level of cultural information about the proposed lease area. Some unintentional damage to subsurface resources could occur during grading or excavation activities. Newly built roads could open previously inaccessible areas to illegal collection or vandalism of archaeological resources; however, implementation of resource protection and mitigation would protect such resources upon discovery.

Water Resources

As with any surface disturbance there would be decreased infiltration rates which may lead to more rapid runoff responses to precipitation events. The cumulative impacts of surface disturbance could lead to: increased occurrence and magnitude of flood events; increased erosion; higher sediment loads in downstream surface waters; and decreased groundwater recharge.

Noxious Weeds

Cumulative adverse effects to resource values because of noxious weeds would be dependent upon the amount of surface disturbance within lease parcel boundary during the well production phase of the lease. Increasing the amount of disturbed ground increases the risk of noxious weed invasion and distribution.

Wildlife

The cumulative adverse effects of full development of oil and gas resources in the Proposed Action could result in a decrease in wildlife populations. Development operations could reduce or eliminate habitat for some species.

Range

Adverse cumulative effects would include reduced acreages for grazing purposes or other detriments, such as increased risk of weed encroachment onto rangelands caused by increased road traffic (seed dispersion), which would reduce desirable vegetation species and, as a result, reduce stocking rates.

6.0 Consultation/Coordination

This section includes individuals or organizations from the public and its' users, external agencies, the interdisciplinary team, and permittees that were contacted during the development of this document.

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On December 17, 2015, a briefing for the NMSO State Director was held to review the CFO recommendations for nominated parcels.

6.1 Public Involvement

The parcels nominated for this sale, along with the appropriate stipulations from the RMP, were posted online for a two week review period December 14, 2015 through December 30, 2015. One external scoping comment letter was received. See Section 1.3 for more information.

This EA was made available for public review and comment for 30 days beginning on February 8, 2016. Any comments provided prior to the lease sale would be considered and incorporated into the EA as appropriate.

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8.0 Authorities

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APPENDIX 1

Lease Stipulations

The following stipulations are attached to at least one of the nominated parcels that appear in Alternative B - Proposed Action.

Stipulation	Description/Purpose
SENM-S-1	CONTROLLED SURFACE USE - POTASH All or a portion of the lease is located within the Secretary of Interior's Designated Potash Area as described in the Secretarial Order No. 3324, signed December 3, 2012. In order to protect potash resources, special protective measures may be developed during environmental analyses and be required as part of approvals for drilling or other operations on this lease.
SENM-S-17	CONTROLLED SURFACE USE – SLOPES OR FRAGILE SOILS Surface disturbance will not be allowed on slopes over 30 percent. Occupancy or use of fragile soils (e.g. dunes, gypsum soils) will be considered on a case-by-case basis.
SENM-S-18	CONTROLLED SURFACE USE – STREAMS, RIVERS, FLOODPLAINS All or portions of the lands under this lease lie in or are adjacent to a major watercourse and are subject to periodic flooding. To protect floodplains, surface occupancy of these areas will not be allowed within up to 200 meters from the outer edge of the floodplain.
SENM-S-19	CONTROLLED SURFACE USE – PLAYAS AND ALKALI LAKES Surface disturbance will not be allowed within up to 200 meters of playas or alkali lakes. Waiver of this requirement will be considered on a case-by-case basis for projects designed to enhance or protect renewable natural resources. An exception for oil and gas development will be considered if playa or lake loss was mitigated by the protection and development of another playa exhibiting the potential for improvement.
SENM-S-21	CONTROLLED SURFACE USE – CAVES AND KARST All or portions of the lease are located in a cave or karst occurrence area. Due to the sensitive nature of cave/karst systems in this area, surface disturbance will not be allowed within up to 200 meters of known cave or karst features or systems.
SENM-S-22	CONTROLLED SURFACE USE – LESSER PRAIRIE-CHICKEN (LPC) Drilling for oil or gas, and 3-D geophysical exploration will not be allowed in LPC (<i>Tympanuchus pallidicinctus</i>) habitat from March 1 through June 15. During that period noise producing activities associated with these operations will not be allowed between 3:00 a.m. and 9:00 a.m. In addition, no new drilling will be allowed within up to 200 meters of leks, and exhaust noise from pump jack engines must not exceed 75 db measured at 30 feet from the source of the noise.
SENM-S-23	CONTROLLED SURFACE USE – DUNES SAGEBRUSH LIZARD (DSL) Surface disturbance will not be allowed in documented DSL (<i>Sceloporus arenicolous</i>) occupied habitat areas or within up to 200 meters of suitable habitat associated with occupied habitat areas identified through field review.

Stipulation	Description/Purpose
SENM-S-25	VISUAL RESOURCE MANAGEMENT - Painting of oil field equipment and structures to minimize visual impacts will be conducted according to the requirements of Notice to Lessees (NTL) 87-1, New Mexico.
SENM-S-34	PLAN OF DEVELOPMENT – LPC/DSL The lease contains habitat suitable for LPC and/or DSL or with habitat manipulation the area could become suitable habitat. In order to reduce the amount of surface disturbance a Plan of Development (POD) for the entire lease will be required.
SENM-S-39	PLAN OF DEVELOPMENT (POD) A POD must be submitted prior to approval of development actions.
SENM-S-43	NO SURFACE OCCUPANCY STIPULATION - PECOS RIVER CORRIDOR SRMA
SENM-S-46	SAND DUNE LIZARD SURVEY REQUIREMENTS & PLAN OF DEVELOPMENT - A survey for occupied and suitable sand dune lizard habitat for the entire lease is required.
SENM-S-47	LEASE RECLAMATION - The subject properties contain wells, roads and/or facilities (well, pad, road, powerline, pipeline, etc.) that were not plugged, removed and/or reclaimed to current standards. Unless the facilities are put to a beneficial and direct use under the new lease, the lessee shall plug, remediate and reclaim the facilities within two years of lease issuance.
SENM-LN-1	LEASE NOTICE – POTENTIAL CAVE OR KARST OCCURRENCE AREA All or portions of the lease are located in a potential cave or karst occurrence area. Special protective measures may be developed during environmental analyses and may be required as approvals for drilling or other operations.
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 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.
NM-LN-11	LEASE NOTICE – CULTURAL RESOURCES All development activities proposed under the authority of this lease are subject to compliance with Section 106 of the National Historic Preservation Act and Executive Order 13007. Compliance could require intensive cultural resource inventories, Native American consultation and mitigation measures to avoid adverse effects.

APPENDIX 2

PHASES OF OIL AND GAS DEVELOPMENT

Construction Activities

Clearing of the proposed well pad and access road would be limited to the smallest area possible to provide safe and efficient work areas for all phases of construction. First all new construction areas need to be cleared of all vegetation. All clearing activities are typically 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 at a minimum the pad, but other features, as needed for development, may include, but is 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. If a reserve pit is authorized, it would be lined using an impermeable liner or other lining mechanism (i.e. bentonite or clay) to prevent fluids from leeching 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 surfaces are typically dressed with a layer of crushed rock or soil cemented. Construction materials come from a variety of sources. Areas not needed for long-term development (i.e. portions of the pipeline or road right-of-way) are reclaimed by recontouring the surface and establishing vegetation.

If a pipeline is needed, the right-of-way would be cleared of all vegetation. The pipeline would be laid out within the cleared section. A backhoe, or similar piece of equipment, would dig a trench at least 36 inches below the surface. After the trench is dug, the pipes would be assembled by welding pieces of pipe together and bending them slightly, if necessary, to fit the contour of the pipeline's path. Once inspected, the pipe can be lowered into the trench and covered with stockpiled subsoil that was originally removed from the hole. Each pipeline undergoes hydrostatic testing prior to natural gas being pumped through the pipeline. This ensures the pipeline is strong enough and absent of any leaks.

Drilling Operations

When the pad is complete, the drilling rig and associated equipment would be moved onsite and erected. A conventional rotary drill rig with capability matched to the depth requirements of the proposed well(s) would be used. The well could be drilled as a vertical or horizontal well to target the desired formation. The depth of the well is entirely dependent on the target formation depth and could be several hundred feet vertical depth to over 20,000 feet vertical depth.

When a conventional reserve pit system is proposed, 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 mud emerges from the hole, it enters into the reserve pit where it would remain until all fluids are evaporated and the solids can be buried.

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

In either situation the mud is maintained at a specific weight and viscosity to cool the bit, seal off any porous zones (thereby protecting aquifers or 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 and is entirely dependent on the site-specific conditions.

Completion Operations

Once a well has been drilled, completion operations would begin once crews and equipment are available. 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 (HF) is one technological key to economic recovery of oil and gas that might have been left by conventional oil and gas drilling and pumping technology. It is a formation stimulation practice used to create additional permeability in a producing formation, thus allowing gas to flow more readily toward the wellbore. 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 (GWPC 2009). The process is not new and has been a method for additional oil and gas recovery since the early 1900s; however, with the advancement of technology it is more commonly used.

Hydraulic fracturing is a process that 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 development, fracture fluids are primarily water-based fluids mixed with additives which help the water to carry proppants into the fractures, which may be made up of sand, walnut hulls, or other small particles of materials. The proppant is 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 of horizontal shale gas wells is 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 uphole as each stage of the treatment is completed until the entire lateral well has been stimulated.

This process 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 percent 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 (see discussion about Hazardous and Solid Wastes below). Because the fluid is composed mostly of water, large volumes of water are usually needed to perform hydraulic fracturing. However, in some cases, water is recycled or produced water is used.

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

To ensure that hydraulic fracturing is conducted in a safe and environmentally sound manner, the BLM approves and regulates all drilling and completion operations, and related surface disturbance on Federal public lands. Operators must submit Applications for Permit to Drill (APDs) to the agency. Prior to approving an APD, a BLM CFO geologist identifies all potential subsurface formations that would be penetrated by the wellbore. This includes all groundwater aquifers and any zones that would present potential safety or health risks that may need special protection measures during drilling, or that may require specific protective well construction measures.

Once the geologic analysis is completed, the BLM reviews the company's proposed casing and cementing programs to ensure the well construction design is adequate to protect the surface and subsurface environment, including the potential risks identified by the geologist and all known or anticipated zones with potential risks.

During drilling, the BLM is on location during the casing and cementing of the ground water protective surface casing and 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 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" fracture for the area, the BLM would always be onsite during those operations as well as when abnormal conditions develop during the drilling or completion of a well.

Production Operations

Production equipment used during the life of the well may include a 3-phase separator-dehydrator; flow-lines; a meter run; tanks for condensate, produced oil, and water; and heater treater. A pump jack 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 above-ground structures not subject to safety considerations are painted a standard BLM or company color or as landowner specified.

Workovers may be performed multiple times over the life of the well. Because 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.

Hazardous or Solid Wastes Associated with Oil and Gas Development

Anticipated use or produced hazardous materials during the development may come from drilling materials; cementing and plugging materials; HF materials; production products (natural gas, condensates, produced water); fuels and lubricants; pipeline materials; combustion emissions; and miscellaneous materials. Appendix 2, Table 1 includes some of the common wastes (hazardous and non-hazardous) that are produced during oil and gas development.

Appendix 2, Table 1. Common wastes produced during oil and gas development.

Phase	Waste
Construction	<ul style="list-style-type: none"> • Domestic wastes (i.e. food scraps, paper, etc.) • Excess construction materials • Used lubricating oils • Solvents • Woody debris • Paints • Sewage
Drilling	<ul style="list-style-type: none"> • 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 • Production testing wastes • Excess construction materials • Scrap metal • Sewage • Rigwash • Excess drilling chemicals • Processed water • Contaminated soil • Domestic wastes
HF	See below
Production	<ul style="list-style-type: none"> • 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) • Tank or pit bottoms • Contaminated soil • Scrap metal
Abandonment/Reclamation	<ul style="list-style-type: none"> • Construction materials • Decommissioned equipment • Contaminated soil • Insulating materials • Sludge

Hydraulic Fracturing

Chemicals serve many functions in hydraulic fracturing, from limiting the growth of bacteria to preventing corrosion of the well casing. Chemicals are needed to insure the hydraulic fracturing job is effective and efficient. The fracturing fluids used for shale stimulations consist primarily of water but also include a variety of additives. The number of chemical additives used in a typical fracture treatment varies depending on the conditions of the specific well being fractured. A typical fracture treatment will use very low concentrations of between 3 and 12 additive chemicals depending on the characteristics of the water and the shale formation being fractured. Each component serves a specific, engineered purpose. The predominant fluids currently being use for fracture treatments in the shale gas plays are water-based fracturing fluids mixed with friction-reducing additives, also known as slickwater (GWPC 2009).

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 (GWPC 2009).

Appendix 2, Figure 1. Typical Chemical Additives Used In Fracturing Fluids (GWPC 2009)

Typically, the fracturing fluids consist of about 99 percent water and sand and about 1 percent chemical additives. The chemical additives are essential to the process of releasing gas trapped in shale rock and other deep underground formation.

Compound	Purpose	Common application
Acids	Helps dissolve minerals and initiate fissure in rock (pre-fracture)	Swimming pool cleaner
Sodium Chloride	Allows a delayed breakdown of the gel polymer chains	Table salt
Polyacrylamide	Minimizes the friction between fluid and pipe	Water treatment, soil conditioner
Ethylene Glycol	Prevents scale deposits in the pipe	Automotive anti-freeze, deicing agent, household cleaners
Borate Salts	Maintains fluid viscosity as temperature increases	Laundry detergent, hand soap, cosmetics
Sodium/Potassium Carbonate	Maintains effectiveness of other components, such as crosslinkers	Washing soda, detergent, soap, water softener, glass, ceramics
Glutaraldehyde	Eliminates bacteria in the water	Disinfectant, sterilization of medical and dental equipment
Guar Gum	Thickens the water to suspend the sand	Thickener in cosmetics, baked goods, ice cream, toothpaste, sauces
Citric Acid	Prevents precipitation of metal oxides	Food additive; food and beverages; lemon juice
Isopropanol	Used to increase the viscosity of the fracture fluid	Glass cleaner, antiperspirant, hair coloring

NORM

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 radium226 and radium228, can be brought to the surface in drill cuttings and produced water. Radon222, 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.