United States Department of the Interior

FEDERAL INDIAN MINERALS OFFICE
6251 College Boulevard, Suite B
Farmington, New Mexico 87402

NOTICE OF AVAILABILITY
FEDERAL INDIAN MINERALS OFFICE OIL & GAS LEASE SALES – December 2021
ENVIRONMENTAL ASSESSMENT

The Federal Indian Minerals Office (FIMO) is releasing a Notice of Availability (NOA) to advise the public that FIMO has prepared an environmental assessment (EA) for the proposed forty (40) nominated Individual Indian allotments competitive closed bid lease sale in December 2021. The nominated allotments total an approximate 6,402.04 acres. The EA was prepared in accordance with the National Environmental Policy Act of 1969 (NEPA)

Project Description

The Proposed Action is the Federal Indian Minerals Office (FIMO) leasing forty (40) nominated Individual Indian allotments that encompasses approximately 6,402.04 acres. The allotments are located in northwestern New Mexico in San Juan and Sandoval County. The competitive bid will be held on December 6, 2021.

The Alternatives analyzed in the EA include: 1) Proposed Action – completing the closed competitive bidding and leasing the forty (40) allotments; 2) The No Action (not leasing the forty (40) allotments); and 3) Analyzed but Not Considered – Adequate restriction to protect resources.

For further information, copies of the EA are available at the Federal Indians Mineral Office at 6251 North College Boulevard, Suite B, Farmington, New Mexico, 87402.

NEPA Process and Comment Period

The NEPA process requires federal agencies to take into consideration the environmental consequences of the proposed actions as well as input from the public and agencies. To comply with the NEPA, an EA has been completed for this action. As part of the NEPA process, public comments, questions, corrections, or concerns are requested for this EA. An electronic copy of the EA is available on the BIA Navajo Region's website: https://www.indianaffairs.gov/regional-offices/navajo.

To submit a written comment or to request paper or electronic copies of the document, please write or contact:

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Please submit any written comments you may have within 30-days, or by November 18, 2021, to the address above. All comments received become part of the public record associated with this action. Accordingly, your comments (including name and address) will be available for review by any person that requests to review the record. At your request, we will withhold your information and address to the extent allowed by the Freedom of Information Act.

United States Department of the Interior

Bureau of Indian Affairs
Navajo Regional Agency
Federal Indian Minerals Office

Environmental Assessment DOI-BIA-EA-18-21172
Drafted March 2020, Revised September 2021

Federal Indian Minerals Office
Oil and Gas Competitive Lease Sale 2021
San Juan and Sandoval Counties, New Mexico

U.S. Department of the Interior
Federal Indian Minerals Office
6251 North College Boulevard, Suite B
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The Federal Indian Mineral Office's (FIMO) mission is to provide and improve Indian trust services to the Navajo individual mineral owners in the management of oil and gas interests on Navajo allotted mineral estate.

The Bureau of Indian Affairs (BIA) Navajo Regional Office's mission is to enhance the quality of life, facilitate economic opportunity, carry out the responsibility to protect and improve the trust assets of the Navajo Nation and individual Indians.

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Acronyms and Abbreviations

ac	Acre
APD	Application for Permit to Drill (BLM Form 3160-3)
AQCR	Air Quality Control Region
ARPA	Archaeological Resources Protection Act
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BMP	Best Management Practice(s)
CAA	Clean Air Act
CCNHP	Chaco Canyon National Historic Park
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CGP	Construction General Permit
COA	Condition(s) of Approval
CRA	Compensatory Royalty Agreement
CO_2e	Carbon dioxide equivalent
DOI	Department of Interior
EA	Environmental Assessment
EOI	Expressions of Interest
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FFO	Farmington Field Office
FIMO	Federal Indian Minerals Office
FLPMA	Federal Land Policy and Management Act
FMV	Fair Market Value
FONSI	Finding of No Significant Impact
ft	Linear foot
GHG	Greenhouse gas
GIS	Geographic Information System
GWP	Global warming potential
IA	Indian Allotted Land(s)
IPCC	Intergovernmental Panel on Climate Change
LTRO	Land Titles and Records Office
MBTA	Migratory Bird Treaty Act
MLA	Minera Leasing Act
MOU	Memorandum of Understanding
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act
NESL	Navajo Endangered Species List
NHD	National Hydrography Dataset
NHPA	National Historic Preservation Act
NMAAQS	New Mexico Ambient Air Quality Standards
NMAC	New Mexico Administrative Code
NMAQB	New Mexico Air Quality Bureau
NMED	New Mexico Environment Department
NNC	Navajo Nation Code
NNCRPA	Navajo Nation Cultural Resources Protection Act
NNDFW	Navajo Nation Department of Fish and Wildlife
NNHHPD	Navajo Nation Heritage and Historic Preservation Department
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places

OHWM	Ordinary High-Water Mark
ONRR	Office of Natural Resources Revenue
OST	Office of Special Trustee for American Indians
RFD	Reasonably Foreseeable Development Scenario
RMP	Resource Management Plan
RMPA	Resource Management Plan Amendment
SOP	Standard of Operating Procedures
SWPPP	Stormwater Pollution Prevention Plans
TCP	Traditional Cultural Property(s)
THPO	Tribal (Navajo Nation) Historic Preservation Officer
TSR	Title Status Reports
USACE	U.S. Army Corps of Engineers
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
VRI	Visual Resource Inventory
VRM	Visual Resource Management

1. PURPOSE AND NEED FOR ACTION

1.1 Background

This Environmental Assessment (EA) documents the Federal Indian Minerals Office (FIMO) review of forty (40) Indian allotment parcels nominated for oil and gas lease sale. The parcels are individual Indian allotments. The allotments were nominated by Industry and the Indian mineral owners requested that the Secretary of the Interior (Secretary) prepare, advertise, and negotiate mineral leases on their behalf (25 C.F.R. § 212.20).

The forty (40) nominated allotments are all parcels of approximately 160 acres (ac), or one Quarter Section. Each consists of a square area 0.5-miles (2,640 linear feet [lf]) on a side. Two allotments are slightly larger, therefore the total area included in this EA is approximately 6,402.04 ac. The Proposed Action and the surrounding vicinity are shown in **Figure 1.1**. For a more detailed description of the location and project see the proposed action **section 2.1 Proposed Action**.

The Secretary of the Interior is authorized on behalf of the federal government to administer the leasing of Indian allotted land (Allotment) for oil and gas mineral development governed by the 1909 Mineral Leasing Act for Allotments. Additional laws for leasing and development of Indian minerals include the Indian Mineral Leasing Act of 1938 and the Indian Mineral Development Act of 1982. Federal Agencies maintain a trust responsibility and a fiduciary relationship with tribes, nations, and individual Indian allottee(s).

The Department of Interior (DOI) established FIMO to provide and improve services to individual Indian beneficiaries in the management of their oil and gas mineral resources. In accordance with Secretary Re-delegation Order 209 Department Manual (DM) 8, 303 DM 2 and 4 authorization were given to FIMO to conduct all aspect of leasing on behalf of the Secretary for the benefit of the individual Indian allottees. FIMO has been structured to consolidate and integrate Indian allotted oil and gas management functions under one line of authority. The Bureau of Indian Affairs (BIA), Bureau of Land Management (BLM), Office of Natural Resources Revenue (ONRR), and Office of Special Trustee for American Indians (OST) share in administering regulatory functions related to oil and gas activities on Indian Allotments. These agencies are the four (4) pillars of FIMO.

The agencies have established common standards and methods for creating efficient and effective working relationships to achieve the overarching DOI goal of accountability for Indian Allotted leases under the FIMO authority.[1] On August 17, 2017, an updated Memorandum of Understanding (MOU; FIMO MOU) between these four agencies was signed. The MOU outlined the working relationships between the agencies for Indian allotment minerals management and the administrative roles and responsibilities.

The Onshore Energy and Mineral Lease Management Interagency Standard of Operating Procedures (SOP) were signed September 2013. The purpose of the SOP is to establish common standards and methods forcreating efficient and effective working relationships to achieve the DOI goal of accurate energy and minerals accountability for onshore Federal and Indian leases.

The SOP outlines the role and responsibilities for Indian oil and gas activities within the various federal agencies. It defines the roles from the beginning of the oil and gas lease to the expiration (of its own terms) or termination (cease of production) of the lease. During the life of the lease, FIMO is responsible for administration and compliance, and BLM is responsible for the operational phase in concurrence with FIMO. The SOP streamlines the roles and responsibilities between BIA and BLM regulations. BIA regulates leasing per 25 Code of Federal Regulations (CFR) Part 212, Leasing of Allotted Lands for Mineral Development. BIA governs leases for the development of individual Indian oil and gas, geothermal, and solid mineral resources. BLM is authorized under 43 CFR 3160-Onshore Oil and Gas Operations, 43 CFR 3180-Onshore Oil and Gas Unit Agreements; Unproven Area, 42 CFR part 3260-Geothermal Resource Operations, 43 CFR part 3280-Geothermal Resources Unit Agreements: Unproven Areas, 43 CFR part 3480-Coal Exploration and Mining Operations, and 43 CFR 3590-Solid Minerals (other than coal). BLM authority and responsibility currently include, but are not limited to, resource evaluation, approval of drilling permits, mining

[1] Onshore Energy and Mineral Lease Management Interagency Standard Operating Procedures, 2013.

and reclamation, production plans, mineral appraisals, inspection and enforcement, and production verification. In addition to the 43 CFR, the BLM Farmington Field Office (FFO) complies with the Land Use Plan outlined in the 2003 Resource Management Plan (RMP; BLM 2003a). In staying true to the intent of the SOP, FIMO follows regulations mandated by BIA and BLM. FIMO utilizes the SOP to adhere with the consent decree directives, dated March 1989 and the 2017 FIMO MOU.

The SOP and the MOU outline FIMOs' responsibility for identifying Indian allotments nominated for oil and gas development for leasing purposes. At the pre-leasing stage, the Indian allotment(s) offered for leasing are identified based on the following criteria:

- Allotment(s) nominated by interested parties,
- Allotment(s) recommended by the BLM,
- Allotment(s) in danger of trespass or loss due to economic conditions,
- Allotment(s) requested by the Indian mineral owner(s),
- Allotment(s) recommended by the BIA.

After receipt of a request, it is necessary to properly identify the allotment(s) by evaluating the potential for mineral development and advertise the Indian lands for leasing by competitive bidding or subsequent negotiations. Expressions of Interest (EOI) on the interested allotment(s) for leasing would be defined by Title Status Reports (TSR) from the Land Title and Records Office (LTRO). Per Title 25: Indians, Chapter I, Subchapter H, Part 150.2 (o), Title Status Report means a report issued after a title examination which shows the proper legal description of a tract of Indian Land; current ownership, including any applicable conditions, exceptions, restrictions, or encumbrances on record; and whether the land is in unrestricted, restricted, trust, or other status as indicated by the records in LTRO. FIMO would obtain this report for each selected allotment(s) to properly identify clearances for mineral leasing.

Per Title 25: Indians, Chapter I, Subchapter H, part 150.2, Definitions: (j) LTRO are those offices within the Bureau of Indian Affairs charged with the Federal responsibility to record, provide custody, and maintain records that affect titles to Indian lands, to examine titles, and to provide title status reports for such land. The LTRO describes Indian lands by allotment(s) number(s), correct legal description(s), correct acreages, and current ownership(s) to ensure each allotment has been clearly identified. Within 30 days of receipt, FIMO request from BLM and/or the Division of Energy and Mineral Development (DEMD) for a Fair Market Value (FMV) analysis. BLM/DEMD will provide FIMO a FMV recommendation, which includes at a minimum recommended royalty rates, rentals, and minimum bonuses. Written Notices are sent to each Indian mineral owner(s) for a meeting to discuss the EOI.

FIMO conducts meetings with the Indian mineral owners to disseminate information concerning the proposed allotment(s) selected for the oil and gas lease sale and the process involved. FIMO would initiate the preparation for advertisement on the selected allotment(s)and forward for legal and technical review. In conformance to the requirements in *4.3 Competitive Bid Sales of Fluid Minerals* from the July 2012 DOI-BIA Fluid Mineral Estate Procedural Handbook, an Environmental Assessment (EA) is initiated for the nominated allotments, as presented in this document. This EA meets the requirements as outlined in the Fluid Mineral Estate Procedural Handbook (BIA 2012).

If an Indian allotment does not receive a successful bid at the time of the proposed lease sale, FIMO may re-advertise the Indian allotment through another competitive or negotiated sale according to 25 CFR 212.20; Leasing Procedures, subject to the consent of the Indian mineral owners, a lease may be processed through a private negotiation. A lease is held at a maximum of five (5) years, after which time the lease expires on its own terms unless the allotment is drilled or there is actual production. A producing lease is held indefinitely by economic production.

Once leased, the lessee has up to five years to submit an Application for Permit to Drill (APD-Form 3160-3) to the BLM and FIMO for review and approval. The APD is a site-specific application that will have conditions of approval (COA) and any other mitigation measures that must be implemented prior to any surface disturbance in preparation for drilling. An APD must demonstrate compliance with any stipulations attached to the controlling lease before the APD may be approved. Before an APD is approved, additional environmental review would occur in accordance with BLM and FIMO regulations to conform with the

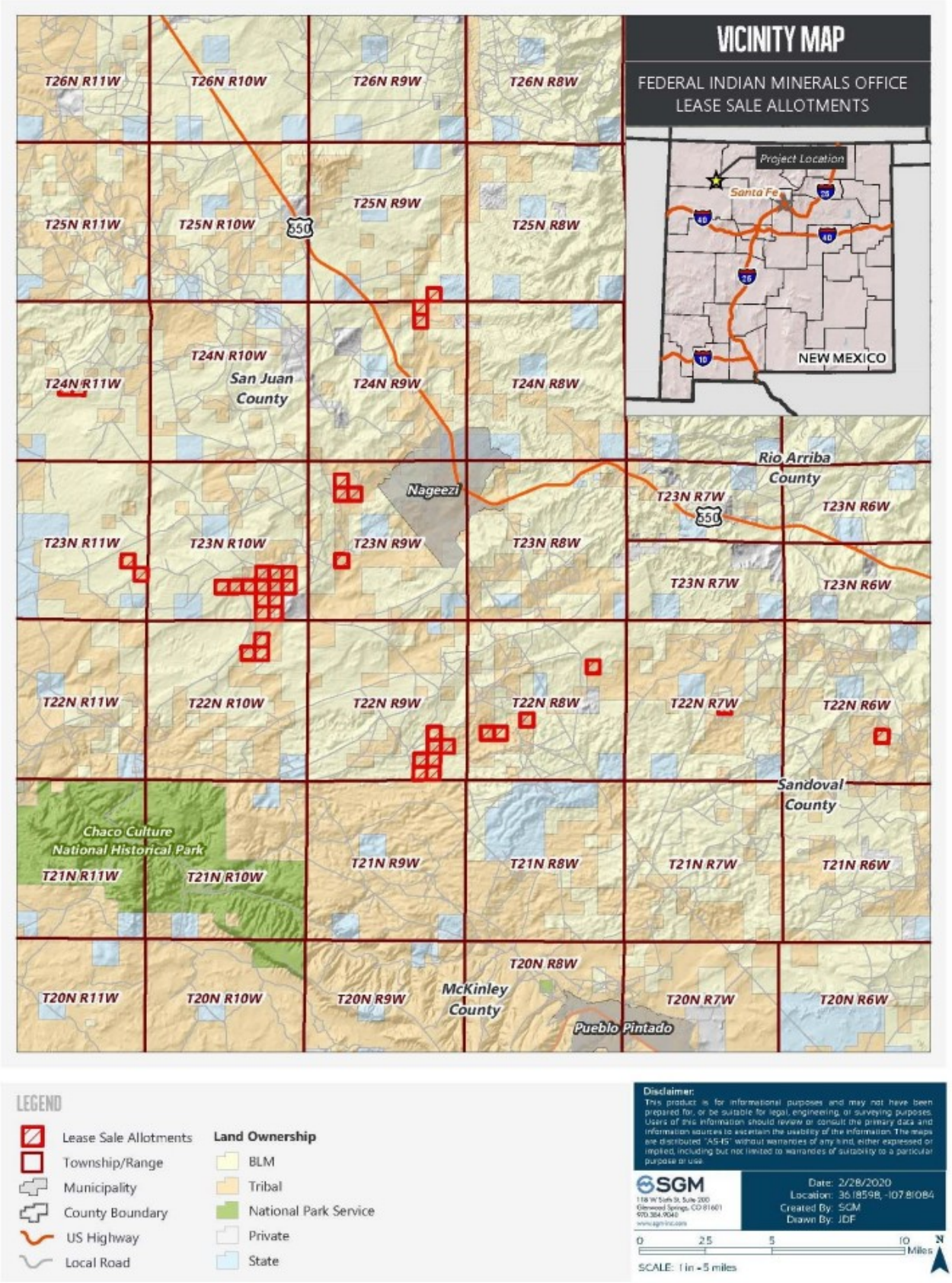
National Environmental Policy Act (NEPA) (42 United States Code [USC] § 4321) guidance (see section 1.5 Relationship to Statutes, Regulations or Other Plans, below).

Leasing operations must be conducted in a manner that avoids unnecessary or undue degradation of the environment and minimizes adverse impacts to the land, air, water, cultural, biological, and visual resources. In addition to complying with the terms of the APD and lease, Lessees must also comply with other federal laws such as the Clean Water Act, Clean Air Act, Endangered Species Act, and National Historic Preservation Act, which are applicable to all actions on Indian lands even though they may not be specifically referenced in the lease or APD. The leases also include mandatory stipulations to prevent degradation of the resource as referenced within the BIA's Oil and Gas Mining Lease—Allotted Indian Lands. The stipulations included with Indian Mineral Leases protect significant surface resources such as archaeological barriers, environmental, soil erosion potentials, water crossings, locations of road, any pipelines (surface or buried), long term systems necessary for drilling or production phase, berming requirements around tanks or other well site locations, water supply for drilling and completion ensures Lessees/Operators are in full compliant with the terms and conditions of the lease to meet the measures of a safe, clean and healthy environment. These stipulations would apply to any Indian surface estate (on or off lease) upon approval of an Indian Mineral Lease.

BLM and FIMO are responsible for ensuring that drainage does not occur. Drainage is the uncompensated loss of hydrocarbons, inert gases, or geothermal resources from wells on adjacent non-jurisdictional lands or jurisdictional lands resulting in revenue losses to the Indian Mineral Owners. Regulations found at 43 CFR 3162.2-2 outline the BLM's authority to protect leased and unleased lands, acquired Indian tribal and allotted mineral interests, from the loss of oil and gas or geothermal resources by drainage and the resulting loss of royalty revenues. The BLM coordinates with FIMO to ensure that drainage of allotted mineral does not occur.

This EA analyzes the Proposed Action which may result in a decision to defer or drop any specific allotment(s), if any, from the lease sale. In addition, the EA will determine the need for additional stipulations to be attached to any specific allotment(s).

Figure 1.1 Vicinity Map



1.2 Purpose and Need for Action

FIMO's purpose is to respond to the Indian mineral owners' interest in leasing their mineral resources by preparing, advertising, and negotiating leases on their behalf, including through a competitive bidding process or private negotiations (25 U.S.C. § 396; 25 C.F.R. § 212.20(b)). The need for this action is established by FIMO's responsibility to administer the leasing of Indian allotted land and ensure that the Indian mineral owner's resources will be developed in a manner that is in their best interest and minimizes any adverse environmental impacts or cultural impacts resulting from such development.

To meet this obligation, FIMO plans to conduct a competitive closed bid lease sale. In accordance with the principles outlined in the SOP and the MOU for identifying allotments to be offered, FIMO has reviewed and determined forty (40) nominated Individual Indian allotments encompassing approximately 6,402.04 acres (**Table 2.3**, **Section 2.1**) will be considered in this EA for inclusion in the lease sale. FIMO will also determine under what terms and conditions each lease should be offered, such that they are in the best interest of the Indian mineral owner (25 CFR §212.3). FIMO has prepared this EA to evaluate the potential impacts of the Proposed Action to the environment, in conformance with the NEPA.

The need for the Proposed Action is established by FIMO's responsibility to administer the oil and gas program to guarantee the continued opportunity for the Indian Allottees to obtain economic stability, and to accomplish the FIMO and BIA mission to develop, conserve and preserve trust assets.

1.3 Decision to be Made

Based on the information provided in this EA, the responsible official at FIMO will decide whether to:

- offer some or all of the forty (40) proposed leases with standard lease stipulations (25 C.F.R. §§ 212.20 and 212.21)
- offer some or all of the forty (40) proposed leases with appropriate additional mitigation stipulations (25 C.F.R. §§ 212.3, 212.7, and 212.20)
- reject some or all of the forty (40) proposed leases and remove them from the lease sale (25 C.F.R. §§ 212.3, 212.7, and 212.20)

FIMO's decision must be based on the best interests of the Indian mineral owner (25 C.F.R. § 212.3). After any lease offering, final leases may not be approved until the individual Indian owner consents (25 C.F.R. § 212.20(c)).

1.4 Relationship to Statutes, Regulations or Other Plans

Purchasers of oil and gas leases are required to comply with all applicable Indian, federal, state, and local laws and regulations, including obtaining all necessary permits prior to any oil and gas development activities.

This EA may use the list in section 4.2 for consultation under the National Historic Preservation Act. Tribes may review the EA during the 30-day public comment posting period.

This EA is a leasing level document and addresses the indirect and cumulative impacts to the Proposed Action; however, since the lease-specific information such as the number and location of well pads, roads, and pipeline corridors are unknown prior to an APD submittal, the potential scope for analysis of direct impacts is limited. The EA does evaluate potential impacts to federally listed species and critical habitat in **Section 3.14**. A literature review was also conducted for the Area of Potential Effect (APE) by the Navajo Nation Heritage and Historic Preservation Department (NNHHPD). This review identified previously recorded cultural resources in accordance with 36 CFR Part 800 and is further discussed in **Section 3.5**.

Prior to the start of any construction activities, the FIMO must be in possession of all the necessary federal, tribal, and state permits or licenses from the respective and appropriate entities (i.e., Navajo Nation, BIA, United States Environmental Protection Agency (EPA), U.S. Army Corps of Engineers (USACE), New Mexico Department of Transportation [NMDOT], etc.). The following is a list of statutes that may apply to a

proposed action. This section is intended to highlight specific statutes, regulations, or other plans. It is not intended to be a comprehensive list; instead, it provides context for the analysis in this EA.

- **Federal Land Policy and Management Act of 1976 (43 USC Ch. 35)** - Governs the management of public lands under the administration of the BLM. The Farmington Resource Management Plan (RMP, September 2003) assesses impacts within the planning area that encompasses the New Mexico portion of San Juan Basin (**Figure 1.1**). The nominated allotments are within the 2003 RMP planning area. The basin supports approximately 18,000 active oil and gas wells and there are more than 2,400 existing wells in the planning area. FIMO manages the Indian allotted minerals with guidance set forth by the 2003 RMP. Leasing, development, and management of Indian allotted minerals were not analyzed in the 2003 RMP document; however, FIMO will be incorporating by reference (40 CFR 1502.21; 43 CFR 46.135) the affected resources and cumulative impacts. This EA will include a brief synopsis of the incorporated information.

  Pursuant to 40 CFR 1508.28 and 1502.21, this EA also incorporates by reference the affected environment and cumulative impacts analysis contained in the 2003 Farmington RMP Final Environmental Impact Statement, Alternative D analysis of Oil and Gas Leasing and Development (pp 4-105 to 4-119). These pages include analysis of oil and gas leasing and development as it pertains to geology and minerals, soils, water resources, air quality, upland vegetation, riparian areas and wetlands, federally listed species, wildlife, rangeland, lands and access, visual resources, cultural resources, paleontology, noise, social and economic conditions, and environmental justice. Assumptions based on the Reasonably Foreseeable Development (RFD) for Northern New Mexico (October 2014) are used in the analysis of impacts in this EA.

- **Archeological and Historic Preservation Act of 1974, as amended (54 U.S.C 312501-312508)** - Provides for the preservation of historical and archeological data (including relics and specimens) which might otherwise be irreparably lost or destroyed as the result of: 1) flooding; building access roads; erection of workers' communities; relocation of railroads and highways; and other alterations of the terrain caused by the construction of a dam by any agency of the United States, or by any private person or corporation holding a license issued by any such agency; or 2) any alteration of the terrain caused as a result of any Federal construction project or federally licensed activity or program.
- **Archaeological Resources Protection Act of 1979, as amended (16 USC § 470 *et seq*.)** - Secures, for the present and future benefit of the American people, the protection of archaeological resources and sites which are on public lands and Indian lands and fosters increased cooperation and exchange of information between governmental authorities, the professional archaeological community, and private individuals.
- **Clean Air Act of 1970, as amended (42 USC § 7401 *et seq*.)** - Defines EPA's responsibilities for protecting and improving the nation's air quality and the stratospheric ozone layer.
- **Clean Water Act of 1977, as amended (33 USC § 1251)** - Establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. As of March 2003, construction activities that disturb one acre or more are now regulated under the NPDES storm water program. The United States Environmental Protection Agency (EPA) Construction General Permit (CGP) regulation states that construction sites must develop and implement storm water pollution prevention plans (SWPPP) and obtain permit coverage from the primacy agency if more than one acre of land is disturbed.
- **Endangered Species Act of 1973 (16 USC § 1531 *et seq*.)** - Protects critically imperiled species from extinction as a consequence of economic growth and development untempered by adequate concern and conservation. FIMO would evaluate and analyze impacts to federally listed species and critical habitat and make project-specific determinations.
- **Migratory Bird Treaty Act of 1918 (16 USC § 703-712)** - Implements the convention for the protection of migratory birds.
- **Mining and Mineral Policy Act of 1970, as amended (30 USC § 21)** - Fosters and encourages private enterprise in the development of economically sound and stable industries and in the orderly

and economic development of domestic resources to help assure satisfaction of industrial, security, and environmental needs.

- **Native American Graves Protection and Repatriation Act of 1990 (25 USC § 3001-3013)** - Provides a process for museums and Federal agencies to return certain Native American cultural items such as human remains, funerary objects, sacred objects, or objects of cultural patrimony to lineal descendants, and culturally affiliated Indian tribes and Native Hawaiian organizations and includes provisions for unclaimed and culturally unidentifiable Native American cultural items, intentional and inadvertent discovery of Native American cultural items on Federal and tribal lands, and penalties for noncompliance and illegal trafficking.
- **National Historic Preservation Act of 1966, as amended (54 U.S.C. 300101 *et seq*)** - Preserves historical and archaeological sites and required federal agencies to consider the impact of their actions on historic properties and provide consulting parties to comment on the impacts. FIMO would consult with the Navajo Nation Tribal Historic Preservation Officer (THPO) regarding determinations related to cultural resources.
- **Wilderness Act of 1964 (16 USC § 1131 *et seq.*)** - Secures for the American people of present and future generations the benefits of an enduring resource of wilderness.
- **Navajo Nation Clean Water Act, Navajo Nation Code (NNC) Title 4 – Environmental Protection**
- **Navajo Nation Solid Waste Regulations 4 NNC § 101 et seq**, as amended by Navajo Nation Council Resolution No. CJY-51-97
- **Navajo Nation Surface Water Quality Standards (4 NNC § 104 & § 201 of the Navajo Nation Clean Water Act, CJY-81-99)**
- **Navajo Nation Primary Drinking Water Regulations (22 NNC § 2501 et seq.)**
- **Navajo Preference in Employment Act**, as amended October 1990, codified as Title 15 Chapter 7 of the NNC.
- **Navajo Nation Cultural Resource Protection Act (CMA-19-88/NNCRPA),**
- **Navajo Nation Policy for the Protection of Jishcháá; Gravesites, Human Remains, and Funerary Items,**
- **Navajo Nation Policy to Protect Traditional Cultural Properties (TCPs),**
- **Navajo Nation Disposition of Cultural Resource Collections Policy.**
- **Navajo Endangered Species List (RDCJA-01-20)**
- **Navajo Nation Resource Conservation Policy (RCS-44-08)**
- **Navajo Nation Golden and Bald Eagle Nest Protection Regulations (RCS-42-08)**
- **Navajo Nation Raptor Electrocution Prevention Regulations (RSC-43-08)**

Once a lease has been granted on an Indian allotment, no disturbance of any kind shall begin until all required clearances, consultation, determinations, easements, permits, and surveys are authorized and approved. The issuance of the APD by BLM is a federal action; BLM will complete NEPA compliance before deciding to approve or deny the APD application. The NEPA compliance will contain appropriate conditions of approval and the applicant must agree to take all appropriate actions, to avoid, minimize, and mitigate unacceptable environmental consequences. Applicants must also agree to follow Best Management Practices (BMP) and appropriate monitoring mitigations imposed by the lease and the APD.

Compliance with Section 7 of the Endangered Species Act will be determined on a site-specific basis. Subsequent NEPA compliance will be completed before implementation of any oil and gas field development or productions activities that may occur as a result of leasing actions covered under this EA. The FIMO will be the lead federal agency for the Section 7 consultation associated with the leasing action. This consultation will include the Navajo Nation Department of Fish and Wildlife (NNDFW) as a technical advisor to FIMO under a Public Law 93-638 contract through BIA. The APD stage will include ESA compliance, including anydirect, indirect, or cumulative impacts to federally listed species.

Compliance with Section 106 responsibilities of the National Historic Preservation Act (NHPA) is achieved through a literature review and consideration of cultural resources within the Area of Potential Effect. This information is summarized in this EA **(Section 3.5)**. In accordance with 36 C.F.R. 800 and NEPA, culturally affiliated tribes will have an opportunity to provide comment during the 30-day EA comment period. In addition, subsequent Section 106 and NEPA compliance to be completed before oil and gas field development or production activities occur will include site-specific cultural resource assessments.

1.5 Scoping, Public Involvement, and Issues

The Council on Environmental Quality (CEQ) regulations state: "NEPA documents must concentrate on the issues that are truly significant to the action in question, rather than amassing needless detail" (40 CFR § 1500.1(b)). 40 CFR § 1500.4(g) directs that the scoping process should be used "not only to identify significant environmental issues deserving of study but also to deemphasize insignificant issues narrowing the scope of the EIS process accordingly." This NEPA document was stared prior to September 2020, therefore per 40 C.F.R. § 1506.13, FIMO is proceeding under this directive.

Public Involvement: After a draft of this EA is prepared and an initial review completed by FIMO, the draft EA along with the list of available Indian allotment(s) and stipulations will be reviewed by the Navajo BIA Regional Office and pertinent working agencies. FIMO works continuously to ensure its process is transparent. FIMO conducted multiple outreach meetings at six (6) Navajo Nation chapter houses[2] with significant interest from the community in the oil and gas resources expressing comments and concerns of the proposed action. These outreach meetings were held at: Counselor, Huerfano, Nageezi, Torreon, Pueblo Pintado and Ojo Encino Chapter Houses. The forty (40) nominated Indian allotments are within the Nageezi, Huerfano and Counselor chapter communities, located primarily in San Juan County, with two additional nominations located in the western part of Sandoval County. FIMO attended planning meetings at the listed Chapter Houses to present information about the proposed lease sale. FIMO has extended briefing to past and current Navajo Nation Presidents, Russell Begaye, and Jonathon Nez. FIMO also scheduled a briefing with the President and staff of the Navajo Nation, in 2018 and 2019. The draft 2021 EAwill be made available for a public-comment period for thirty days on the BIA website. [3] Additionally, FIMOwill post hardcopies of the draft 2021 EA for public review at the Counselor, Huerfano, and Nageezi Chapterhouse during the commenting period. Comments received will be read and examined, with substantive comments extracted and addressed. These comments will then be responded to systematically.

Based on the public involvement and outreach efforts, the following issues have been determined relevant to the analysis of the Proposed Action and were recommended for inclusion in the EA:

Table 1.1 Resource Issues Identified for the Proposed Action

Air Resources	How would the Proposed Action impact air quality in the region, as a result of leasing?	**Section 3.1**
Cultural Resources	How would reasonably foreseeable surface disturbance associated with the Proposed Action affect cultural resources or traditional cultural properties?	**Section 3.2**
Grazing & Rangeland Resources	How would the Proposed Action affect livestock grazing and range improvements in the grazing allotments surrounding the Proposed Action?	**Section 3.3**
Hydrologic Resources	How would the Proposed Action affect the surface hydrology and existing surface water resources?	**Section 3.4**

[2] A Chapter house is an administrative, communal meeting place on the territory of the Navajo Nation where residents have a forum to express their opinions to their Navajo Nation Council Delegate or to learn about and decide on matters concerning their chapter.
[3] Accessible at Nageezi, Huerfano, Counselor, Ojo Encino, Pueblo Pintao and other chapters in Eastern Navajo Agency.

Paleontological Resources	How would reasonably foreseeable surface disturbance associated with the Proposed Action affect paleontological resources?	**Section 3.5**
Soils	How would reasonably foreseeable surface disturbance associated with the Proposed Action affect soils?	**Section 3.6**
Socioeconomics & Environmental Justice	How would the proposed Action affect the economics and environmental conditions of the surrounding population?	**Section 3.7**
Special Designations	How would the Proposed Action affect existing Special Designations on the surrounding public lands?	**Section 3.8**
Vegetation & Special Status Plant Species	How would the Proposed Action affect existing vegetation resources and expected future conditions?	**Section 3.9**
Visual Resources & Night Skies	How would reasonably foreseeable surface disturbance associated with the Proposed Action affect existing visual conditions in the vicinity?	**Section 3.10**
Wildlife & Special Status Animal Species	How would the Proposed Action affect habitat and ecological conditions for wildlife and migratory birds? How would the Proposed Action affect special status species?	**Section 3.11**

CEQ NEPA regulations address the delineation of non-significant concerns in 40 CFR § 1501.7 as, "…identify and eliminate from detailed study the issues which are not significant, or which have been covered by prior environmental review (40 CFR § 1506.3)." The following issues were considered by FIMO as insignificant included those:

- Outside the scope of the Proposed Action,
- Pre-determined by law, regulation, or other higher-level decision,
- Unrelated to the decision to be made, or
- Conjectural and not supported by scientific or factual evidence

In addition, several specific resource concerns were considered and then dismissed from further analysis in the EA due to a lack of reasonably foreseeable impacts:

Table 1.2 Resource Issues Considered but Eliminated from Further Consideration

Riparian Resources	There are no riparian resources in the vicinity of the Project.
Hunting, Fishing, and Gathering	The environment of the proposed lease parcels has minimal value for hunting and fishing due to the nature of the terrain and existing, competing uses. The Proposed Action could result in the disturbance of approximately 4% of each lease parcel if development occurs. This level of disturbance would not preclude gathering activities on the lease parcels.
Timber Harvesting	The environment of the proposed lease parcels has minimal timber stock, with the majority of the parcels lacking woody vegetation.
Transportation Networks	The proposed lease parcels have minimal public transport networks. No new public transport would be constructed as a reasonably foreseeable consequence of the Proposed Action, and the Proposed Action would not significantly change the nature or amount of use on existing public transport networks.

1.6 Bureau of Indian Affairs NEPA Crosswalk

The Bureau of Indian Affairs (BIA) NEPA Handbook (page 20; BIA 2012) includes a list of all resource issues that must be considered to comply with BIA standards for the preparation of NEPA documents. While this EA has been prepared in accordance with BLM resource categories, BIA resource concerns have been reviewed, and **Table 1.3** provides a crosswalk between all BIA-required resource analyses and the corresponding BLM resource impact assessment.

Table 1.3 Indian Affairs NEPA Handbook Resource Concerns

BIA Handbook Resource	Corresponding BLM Resource Impact Assessment and Section #
Land Resources: Topography	Soils (3.6), Vegetation (3.9)
Land Resources: Soils	Soils (3.6)
Land Resources: Geology, Minerals, and Paleontological	Soils (3.6), Paleontological Resources (3.5), RFD (Appendix D)
Water Resources	Hydrologic Resources (3.4)
Air	Air Resources (3.1)
Living Resources: Wildlife	Wildlife and Special Status Species (3.11)
Living Resources: Vegetation, Ecosystems	Vegetation and Special Status Plant Species (3.9)
Living Resources: Agriculture	Grazing and Rangeland Resources (3.3)
Cultural Resources	Cultural Resources (3.2)
Socioeconomic Conditions	Socioeconomics & Environmental Justice (3.7)
Resource Use Patterns: Hunting, Fishing and Gathering	Not Analyzed in Detail (Table 1.2)
Resource Use Patterns: Timber Harvesting	Not Analyzed in Detail (Table 1.2)
Resource Use Patterns: Agriculture	Grazing and Rangeland Resources (3.3)
Resource Use Patterns: Mineral Extraction	Proposed Action (2.1), RFD (Appendix D)
Resource Use Patterns: Recreation	Special Designations (3.8)
Resource Use Patterns: Transportation Networks	Not Analyzed in Detail (Table 1.2)
Resource Use Patterns: Land Use Plans	Relationship to Statutes, Regulations, or Other Plans (1.4)

Other Values: Wilderness	Special Designations (3.8), Visual Resources & Night Skies (3.10)
Other Values: Noise and Light	Visual Resources & Night Skies (3.10)
Other Values: Visual	Visual Resources & Night Skies (3.10)
Other Values: Public Health and Safety	Public Health & Safety (3.12)
Other Values: Climate Change (Greenhouse Gases)	Air Resources (3.1)
Other Values: Indian Trust Assets	Proposed Action (2.1)
Other Values: Hazardous Materials	Public Health & Safety (3.12)

2. ACTION AND ALTERNATIVE(S)

This chapter identifies and describes the alternatives evaluated in this EA. The Proposed Action and No Action Alternative. The potential environmental effects of these alternatives are compared in **Chapter 3**. A brief explanation of other alternatives that were considered but dismissed from further analysis is provided later in this chapter.

2.1 Proposed Action

The Proposed Action would offer to lease forty (40) nominated Indian allotments in surface and minerals administered by the FIMO (**Figure 1.1**). Each lease covers 160ac (with two exceptions that are slightly larger), for a total proposed lease area of approximately 6,402.04ac. Nominated Indian allotments are shown in **Figure 2.1** to **Figure 2.5**. Lease stipulations are listed in the FIMO stipulations (**Appendix A**).

Oil and gas leases are issued for a five (5)-year period and continue if oil and gas is produced in paying quantities. If a lessee 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 re-offered in another sale.

The leasing action is solely an administrative process and subsequent NEPA compliance and permit approval would be required for future oil and gas development and production activities that may occur as a result of the leasing action. Drilling of wells is not permitted until the lease owner or operator submits a complete APD package in accordance with requirements under the BLM's Onshore Oil and Gas Orders listed in 25 CFR 212, and the APDs are approved. An APD is not approved until site-specific environmental compliance is conducted, per NEPA guidance. Site-specific mitigation measures and best management practices (BMPs) would be brought forth from the NEPA document and attached as COAs for each proposed exploration and development activity authorized on a lease. The allotments recommended for leasing under the Proposed Action and estimated lifetime production amounts are presented below in **Table 2.3**.

Standard terms and conditions, and lease stipulations from FIMO through the allotment review and analysis process would apply (as required by 43 CFR 3101.3) to address site-specific concerns or new information not identified in the land use planning process.

Although the leasing action itself does not involve any surface disturbance or direct impacts to the majority of the resources of concern, it does create a reasonably foreseeable likelihood of subsequent energy development on the parcels as a result of the leasing action. The estimates of the extent and nature of likely

impacts that would be associated with the development of these lease parcels are based on the existing analysis for the FFO Mancos-Gallup planning area (Crocker and Glover 2018).

Based on a site-specific analysis of the lease parcels (**Appendix D**), the level of development likely to occur on each parcel has been estimated depending on the hydrocarbon occurrence potential of each parcel. The parcels break into three categories, based on the potential for horizontal development: High (11 parcels), Medium (27 parcels), and Low (2 parcels).

- High-potential parcels would have a single well pad hosting 2 horizontal wells.
- Medium-potential parcels would have a single well pad hosting 1 horizontal well.
- Low-potential parcels would have two smaller well pads, each hosting a single vertical well.

Based on existing development standards, the horizontal well pads would be expected to cover 6.25 acres of surface area after interim reclamation is complete. In addition to the well pad, access roads and flowlines would also be required, which would be expected to disturb another 0.6 acres on each parcel. Therefore each 160-acre parcel would be expected to include 6.85 acres of surface disturbance under reasonably foreseeable development.

This level of development would necessitate the installation of typical ancillary equipment, and would involve construction activity as described in **Appendix B**. For the purposes of the indirect impacts' assessment of this document, it is assumed that there is a reasonable likelihood that activity similar to that described in **Appendix B** would occur: total surface disturbance for each well pad, access road, and pipeline is estimated at 6.85 acres once interim reclamation has been completed on the well pad construction surface. This amounts to 4.2% of the total surface of each lease parcel.

The two parcels that are in areas of "Low Potential" for horizontally developed plays would be expected to host two well pads each. Each well pad would have a single vertical well. Vertical wells can be accommodated on smaller drilling pads; therefore, based on existing development standards, these well pads would be expected to cover 3.75 acres of surface area each after interim reclamation is complete. In addition to the well pad, access roads and flowlines would also be required, which would be expected to disturb another 0.6 acres per pad on each parcel. Therefore, these two 160-acre parcel would be expected to include 8.70 acres of surface disturbance under reasonably foreseeable development. This amounts to 5.4% of the total surface of each lease parcel. The general construction activity described in **Appendix B** would be substantially similar to all other parcels.

Table 2.1 Production Summary for All Parcels

Hydrocarbon Occurrence Potential[1]	Allotment Numbers	Total Lifetime Oil Production (bbl)	Total Lifetime Gas Production (MCF)	Total Lifetime Water Production (bbl)
High	211478, 211425, 211425M, M180, M10, M11, 6, 16, 261, 263, 264	164,000	2,576,000	132,000
Moderate	107, 116, 121, 122, 118, 117, 120, 119, 128, 131, 220, 219, 235, 234, 233, 172, 260245, 265, M259, 236, 237, 228, 229, 223, 224, 226, 260	82,000	1,288,000	66,000
Low	211609, 211610	82,000[2]	1,288,000[2]	66,000[2]

[1] Hydrocarbon potential for horizontally developed plays, as identified in Crocker & Glover 2018

[2] Total production expected from the parcel, including production from two vertical wells

Table 2.2 Surface Disturbance Summary for All Parcels

Hydrocarbon Occurrence Potential[1]	Allotment Numbers	Number of Wells	Number of Well Pads	Well Pad Disturbance	Road & Flowline Disturbance	Total Parcel Disturbance
High	211478, 211425, 211425M, M180, M10, M11, 6, 16, 261, 263, 264	2	1	6.25 acres	0.6 acres	6.85 acres 4.2% of total
Moderate	107, 116, 121, 122, 118, 117, 120, 119, 128, 131, 220, 219, 235, 234, 233, 172, 260245, 265, M259, 236, 237, 228, 229, 223, 224, 226, 260	1	1	6.25 acres	0.6 acres	6.85 acres 4.2% of total
Low	211609, 211610	2	2	3.75 acres	0.6 acres	8.70 acres[2] 5.4% of total

[1] Hydrocarbon potential for horizontally developed plays, as identified in Crocker & Glover 2018

[2] Total disturbance expected on the parcel, including two well pads and associated access roads/flowlines

2.1.1 Legal Description

The legal land description (New Mexico Principal Meridian [NMPM]) of each of the parcels comprising the Proposed Action are shown below in **Table 2.3.** All parcels are located on Indian Allotment lands.

Specific dimensional calculations for each of the parcels included in the Proposed Action are not provided, since all parcels consist of a single contiguous Quarter Section of approximately 160ac. Dimensional calculations of acreage inform the resource impact assessments included in this document3 and are based on this assumption of 160ac per proposed lease. These acreage estimates do not account for the specifics of development on individual leases, but simply consider the total surface area of each lease in reference to the resources of concern.

Table 2.3 Legal Description – FIMO Oil and Gas Lease Sale

Allotment	Acres	TWN	RNG	Sec	QTR	Hydrocarbon Occurrence Potential	Lease Stipulations*	Chapter
107	160	22N	8W	30	NE	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi
116	160	22N	9W	25	SW	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi
121	160	22N	9W	26	NE	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi
122	160	22N	9W	26	SE	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi
118	160	22N	9W	35	NW	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi
117	160	22N	9W	35	NE	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi
120	160	22N	9W	35	SW	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi
119	160	22N	9W	35	SE	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi

Allotment	Acres	TWN	RNG	Sec	QTR	Hydrocarbon Occurrence Potential	Lease Stipulations*	Chapter
128	160	22N	8W	29	NW	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi
131	160	22N	8W	12	SW	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi
220	160	23N	11W	24	SW	Medium	BIA-2, 3, 4, 5, 11, 16, and 17	Nageezi
219	160	23N	11W	25	NE	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi
235	160	23N	10W	28	SE	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi
234	160	23N	10W	27	SW	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi
233	160	23N	10W	27	SE	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi
172	160	22N	7W	22	NE	Medium	BIA-2, 3, 4, 5, 11, and 16	Counselor
211478	160	25N	9W	35	SE	High	BIA-2, 3, 4, 5, 11, and 16	Huerfano
211425	160.44	24N	9W	2	NW	High	BIA-2, 3, 4, 5, 11, and 16	Nageezi
211452M	160	24N	9W	2	SW	High	BIA-2, 3, 4, 5, 11, and 16	Nageezi
211610	160	24N	11W	22	NW	Low	BIA-2, 3, 4, 5, 11, and 16	Huerfano
211609	160	24N	11W	21	NE	Low	BIA-2, 3, 4, 5, 11, and 16	Huerfano
M180	160	22N	8W	11	SE	High	BIA-2, 3, 4, 5, 11, and 16	Nageezi & Counselor
M10	160	23N	9W	8	NW	High	BIA-2, 3, 4, 5, 11, and 16	Nageezi
M11	160	23N	9W	5	SW	High	BIA-2, 3, 4, 5, 11, and 16	Nageezi
6	160	23N	9W	8	NE	High	BIA-2, 3, 4, 5, 11, and 16	Nageezi
16	161.6	23N	9W	5	NW	High	BIA-2, 3, 4, 5, 11, and 16	Nageezi
260245	160	22N	6W	27	NE	Medium	BIA-2, 3, 4, 5, 11, and 16	Counselor
265	160	23N	10W	26	NW	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi
261	160	23N	10W	26	NE	High	BIA-2, 3, 4, 5, 11, and 16	Nageezi
263	160	23N	10W	25	NW	High	BIA-2, 3, 4, 5, 11, and 16	Nageezi
M259	160	23N	10W	26	SW	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi
264	160	23N	10W	25	SW	High	BIA-2, 3, 4, 5, 11, and 16	Nageezi
236	160	23N	10W	35	NW	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi
237	160	23N	10W	35	NE	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi

Allotment	Acres	TWN	RNG	Sec	QTR	Hydrocarbon Occurrence Potential	Lease Stipulations*	Chapter
228	160	23N	10W	35	SE	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi
229	160	23N	10W	35	SW	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi
223	160	22N	10W	2	SW	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi
224	160	22N	10W	11	NW	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi
226	160	22N	10W	10	NE	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi
260	160	23N	10W	26	SE	Medium	BIA-2, 3, 4, 5, 11, and 16	Nageezi

***BIA Lease Stipulations are provided in Appendix A**

2.2 No Action

The BIA NEPA Guidebook (59 IAM 3-H; BIA 2012) states that for EAs on externally initiated proposed actions such as this leasing proposal, the No Action alternative generally means that the action would not take place. In the case of a lease sale, this would mean that an EOI to lease (i.e., an allotment nomination) would be deferred, and the forty (40) allotments would not be offered for lease during the 2021 lease sale. Surface management and any ongoing oil and gas development on surrounding federal, private, Indian allotted, Navajo tribal trust and state leases would continue under current guidelines and practices.

The No Action alternative may result in the development of producing wells on lands adjacent to the Indian mineral estate lands not offered for lease. Since FIMO and BLM are mandated by law to ensure that there is no uncompensated drainage of Indian minerals, the Indian Allottee(s) would enter into a Compensatory Royalty Agreement (CRA) to collect royalties in the event of adjacent wells being developed. The Allottee(s) would not be compensated for the lease resulting in decreased monetary compensation. Selection of the No Action alternative would not prevent these allotments from future nomination.

2.3 Alternatives Considered but Eliminated from Detailed Study

Alternatives to the Proposed Action are developed to explore different ways to accomplish the purpose and need while minimizing environmental impacts and resource conflicts and meeting other agency objectives. Consistent with CEQ guidelines (40 CFR § 1502.13), FIMO need only analyze a “reasonable range of alternatives.” In general, alternatives with greater adverse resource impacts or those that are not feasible because of existing physical constraints or infrastructure are not brought forward for detailed analysis in this EA. FIMO considered but not carried forward because there is adequate restriction to protect resources and uses.

Figure 2.1 Proposed Action Map A

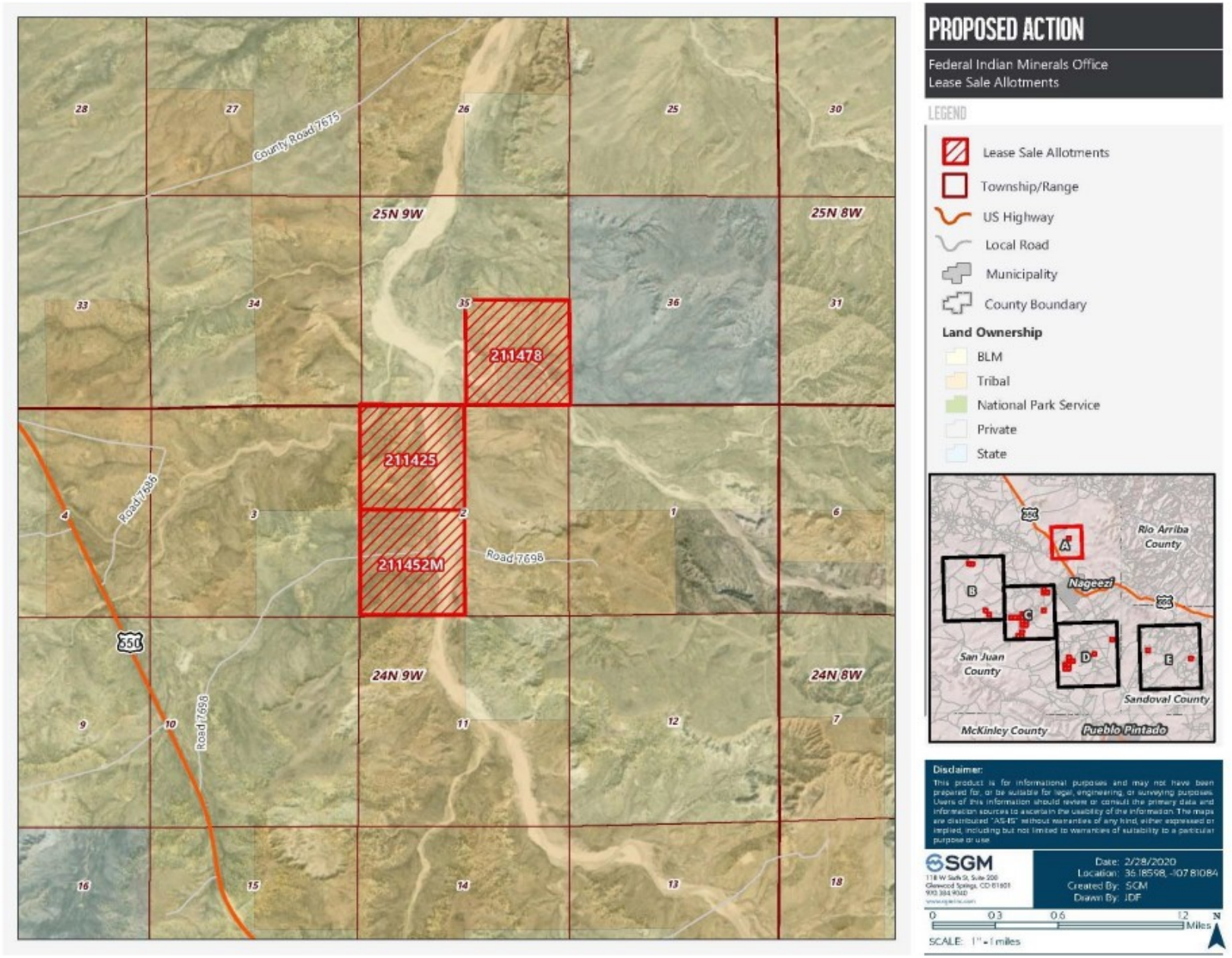


Figure 2.2 Proposed Action Map B

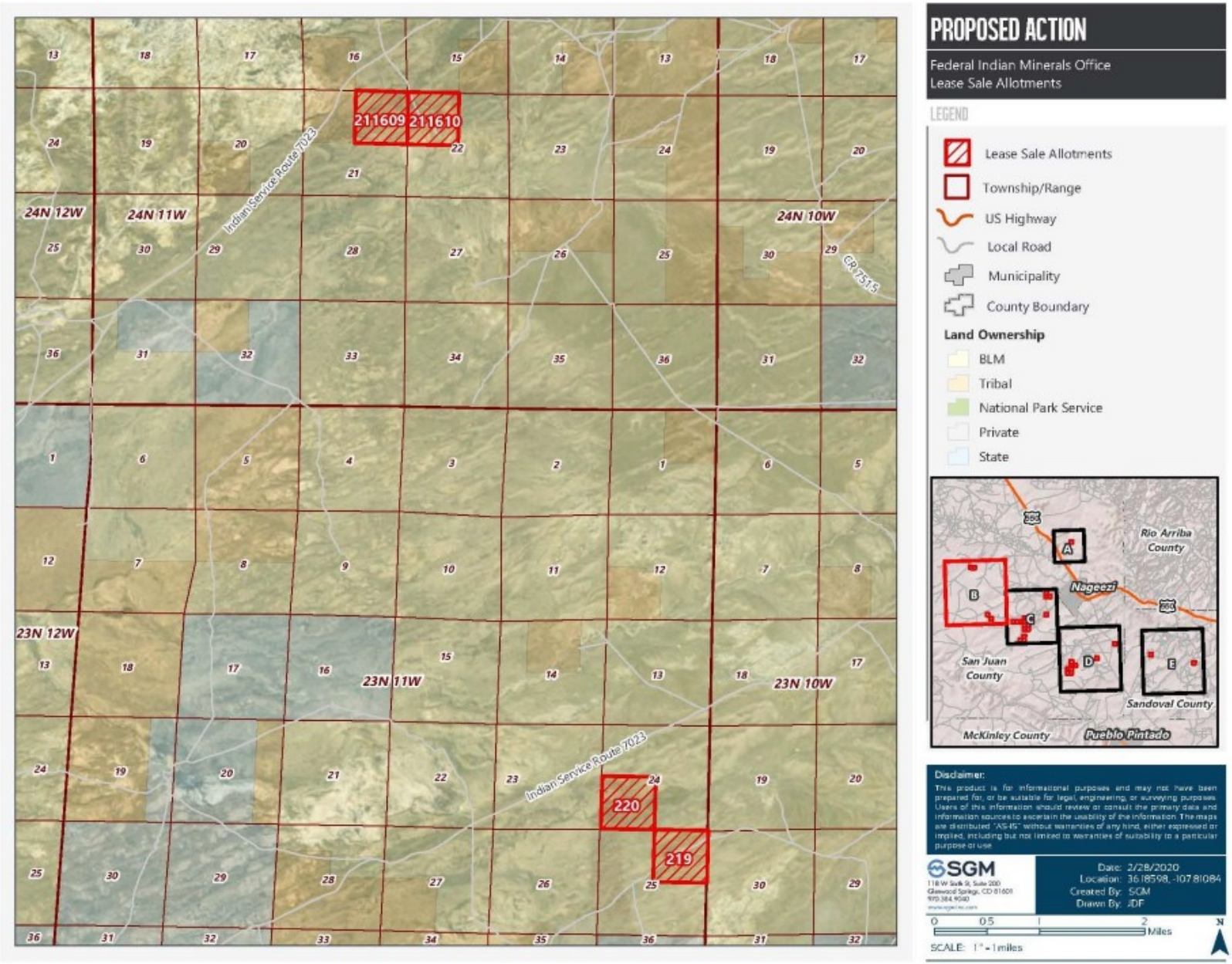


Figure 2.3 Proposed Action Map C

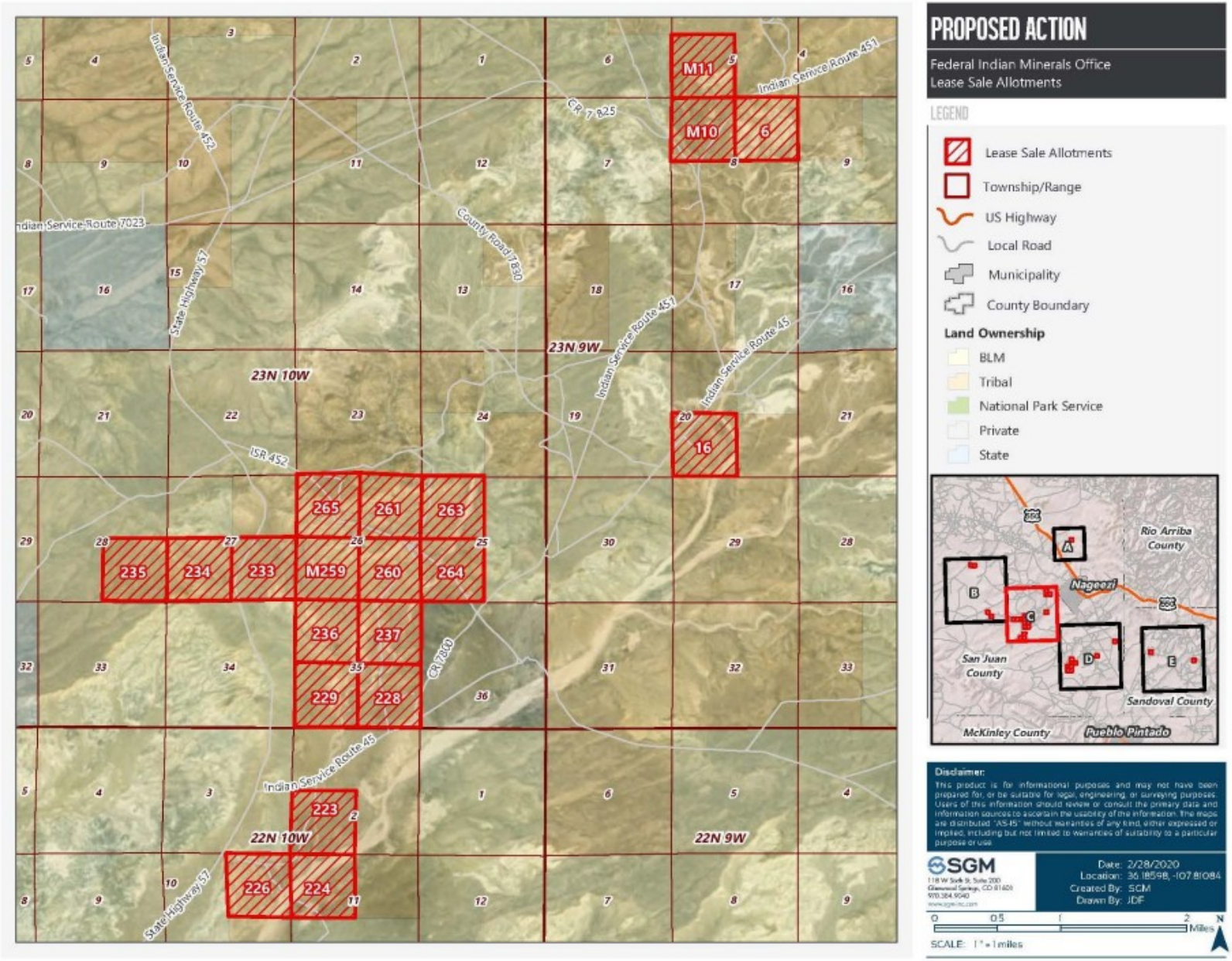


Figure 2.4 Proposed Action Map D

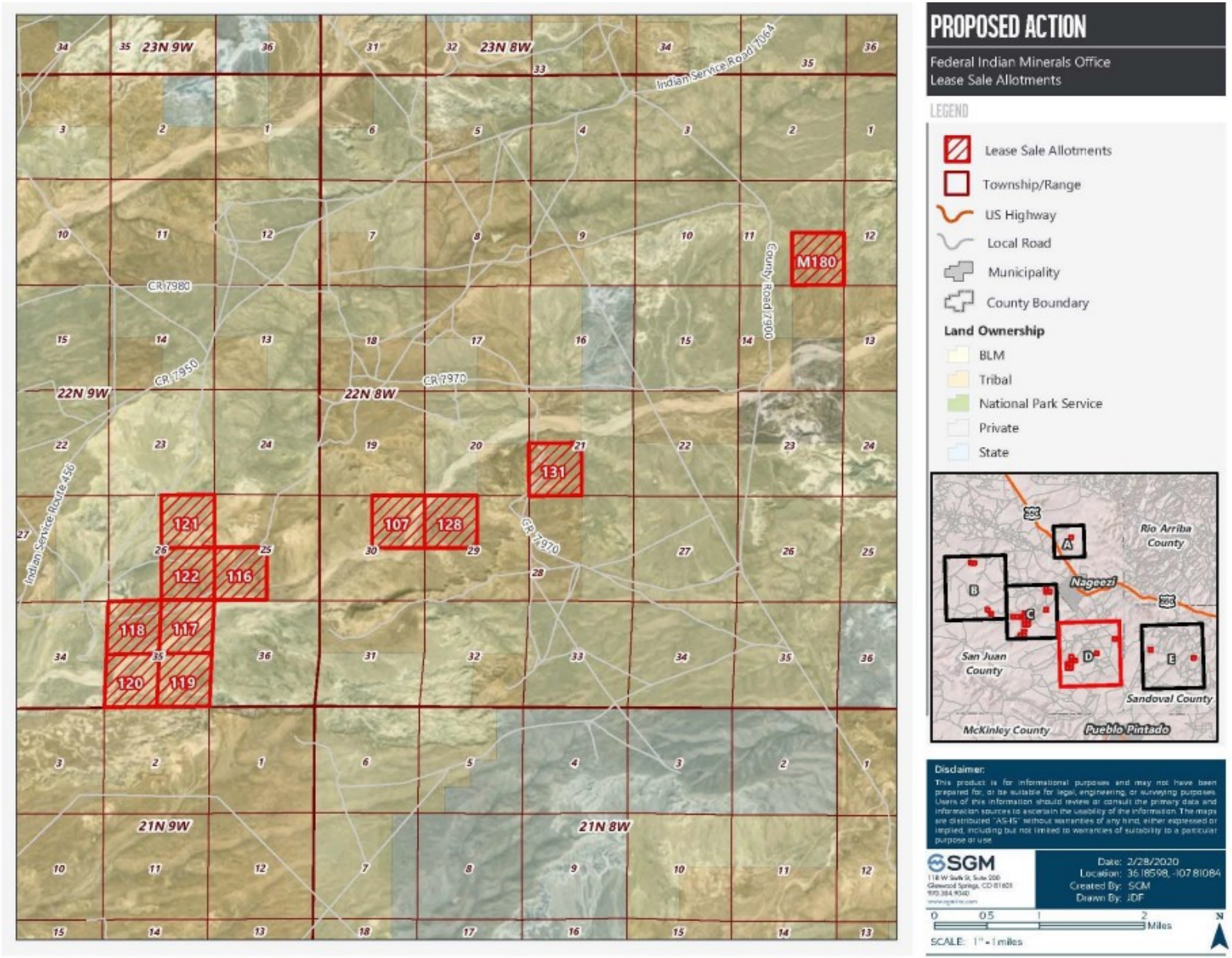
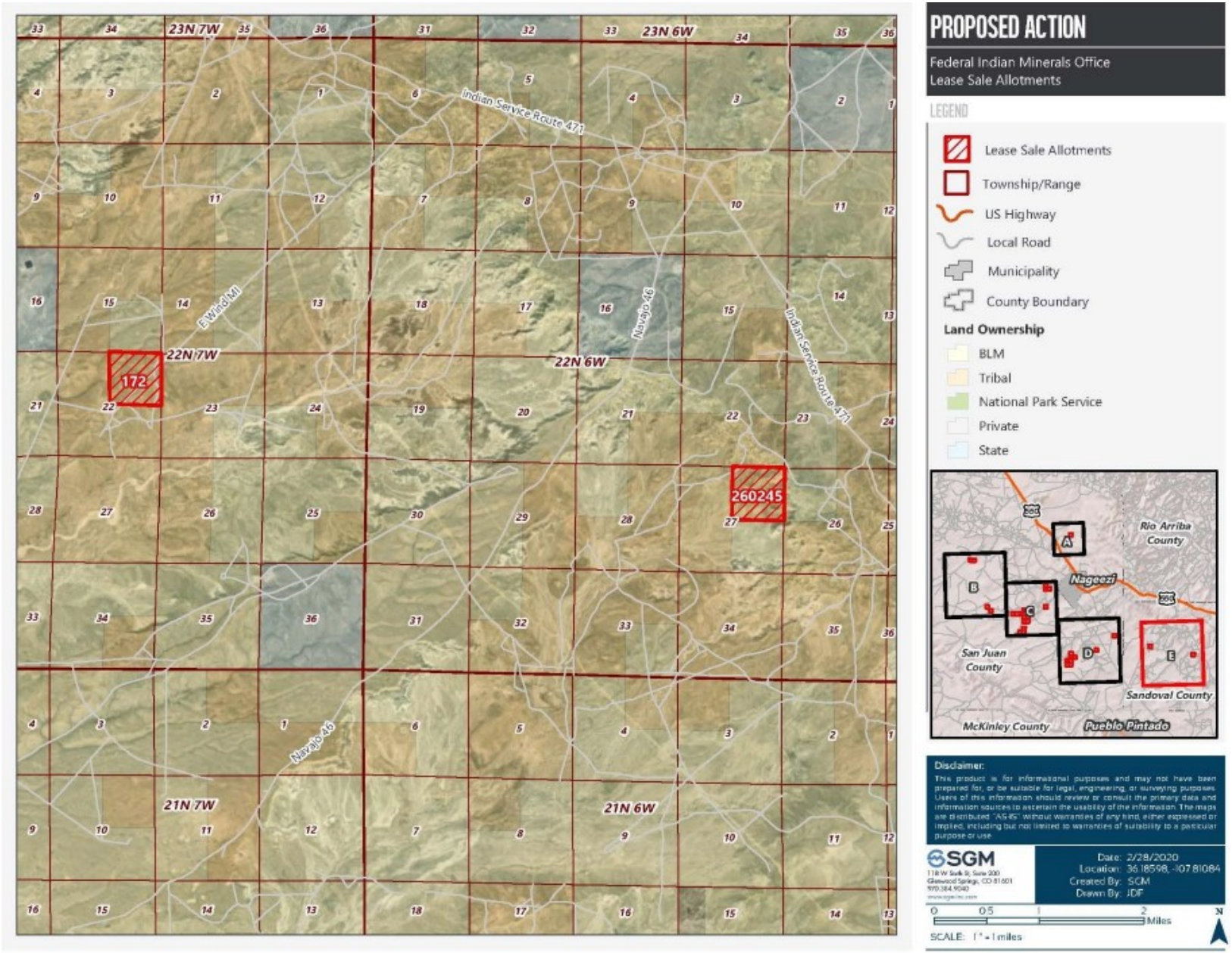


Figure 2.5 Proposed Action Map E



3. AFFECTED ENVIRONMENT & ENVIRONMENTAL IMPACTS

This chapter presents an analysis of the relevant resource concerns identified through internal interdisciplinary team scoping and is summarized in **Section 1.6** and discloses the potential direct, indirect, and cumulative impacts of the proposed action. In conformance with guidance from the CEQ, the discussion is limited to those resources where the degree of reasonably foreseeable potential impact warrants a detailed analysis. This determination was made by FIMO and is summarized in **Table 1.1** and **Table 1.2**.

3.1 Impacts of the No Action Alternative for all Issues

A separate analysis for each issue analyzed in detail in this EA is not provided for the No Action Alternative. Under the No Action Alternative, FIMO would not lease parcels and the existing conditions and trends related to each issue described in the affected environment would continue. Potential impacts associated with the Proposed Action would not occur under this alternative and current land and resource uses would continue. Oil and gas development would continue leased land surrounding the nominated lease parcels. No natural gas or crude oil from the nominated lease parcels would be produced, and no royalties would accrue to the Individual Indian Allottees. Indian mineral interest owners would not realize or see revenue from their mineral interests. Employment and revenue opportunities in local communities related to the oil and gas and service support industry could be lowered under this alternative

3.2 Air Resources

How would future potential development of the lease parcels impact air quality (particularly with respect to the NAAQS and VOCs) in the analysis area?

Air quality is determined by the quantity and chemistry of atmospheric pollutants in consideration of meteorological factors (i.e., weather patterns) and topography, both of which influence the dispersion and concentration of those pollutants. The presence of air pollutants is due to several different and widespread sources of emissions. The analysis area for this issue is the entirety of McKinley, Rio Arriba, Sandoval, and San Juan counties. This spatial scope of analysis was identified based on the regional nature of air pollution and to facilitate analysis using the best available air quality data, which are generally provided at the county level. Much of the information in this section is incorporated from the *BLM Air Resources Technical Report for Oil and Gas Development, New Mexico, Oklahoma, Texas, and Kansas* (BLM 2019) (herein referred to as Air Resources Technical Report and incorporated into this EA by reference).

3.2.1 Affected Environment

The Clean Air Act (CAA) requires the EPA to set NAAQS for pollutants considered harmful to public health and the environment. Primary standards provide public health protection, and secondary standards provide for public welfare, including protection against degraded visibility and damage to animals, crops, vegetation, and buildings (EPA 2019a). The primary NAAQS are set at a level to protect public health, including the health of at-risk populations, with an adequate margin of safety (EPA 2019a).

The EPA has set NAAQS for six principal pollutants ("criteria" air pollutants): carbon monoxide (CO); nitrogen dioxide (NO_2); ozone (O_3); particulate matter equal to or less than 10 microns in diameter (PM_{10}) and particulate matter equal to or less than 2.5 microns in diameter ($PM_{2.5}$); sulfur dioxide (SO_2); and lead (Pb) (EPA 2019b). The EPA has delegated the responsibility of regulation and enforcement of the NAAQS to the state level and has approved the New Mexico State Implementation Plan, which allows the State to enforce both the New Mexico Ambient Air Quality Standards (NMAAQS) and the NAAQS on all public and private lands with the exception of tribal lands and lands within Bernalillo County.[4] The NMED Air Quality

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

Bureau is responsible for implementation of the State Implementation Plan and enforcement of air quality standards (BLM 2019).

Areas that are in attainment of the NAAQS are categorized as either Class I, Class II, or Class III, which determines the increment of air quality deterioration allowed. All areas that attain the NAAQS and are not specifically designated as Class I areas[5] under the CAA are Class II for air quality, where a moderate amount of degradation is permitted. The analysis area is in attainment for the NAAQS and the NMAAQS and is categorized as a Class II area (EPA 2019c; NMED 2018b).
The Clean Air Act established certain national parks and wilderness areas as mandatory Class I areas where only a small amount of air quality degradation is allowed. The nearest Class I area to the lease parcels is the San Pedro Parks Wilderness, about 19 miles south of the nearest parcel. Federal land manager may identify Class II lands under their jurisdiction that are sensitive to air pollution. These are referred to as sensitive Class II areas and may include wilderness areas, national wildlife refuges, national monuments, national historic parks, and national recreation areas that were not formally designated as Class I areas. The nearest sensitive Class II areas to the lease parcels are the Aztec Ruins National Monument, about 12 miles northeast of Farmington, New Mexico, and 35-65 miles north of the proposed lease parcels; and the Chaco Canyon Historic Park, about 48 miles south-southeast of Farmington, and 5-20 miles west of the proposed lease parcels.

Air Quality Related Values (AQRVs) are resources sensitive to air quality and can include a variety of atmospheric-chemistry related indicators. The primary AQRVs of concern are visibility and acidic deposition. Visibility impairment or haze is caused when sunlight encounters tiny pollution particles in the atmosphere and is either absorbed or scattered, which reduces the clarity and color of what can be seen. Deciviews or standard visual range are terms used to express visibility. Acidic deposition occurs when nitrates and sulfates formed in the atmosphere are deposited to soil, vegetation, and surface water. Acid deposition to lakes can impair water quality by reducing their acid-neutralizing capacity.

Criteria Pollutant Concentrations

Concentrations of air pollutants are measured at air monitoring sites and expressed in parts per million (ppm), parts per billion (ppb), or micrograms per cubic meter ($\mu g/m^3$) depending on the unit of measure for a specific standard. The EPA and New Mexico periodically analyze and review air monitor locations and will discontinue monitoring where pollutant concentrations have been well below standards or may add monitors in areas where concentrations may be suspected of approaching the NAAQS or the NMAAQS (BLM 2019).[6]

Design values are the concentrations of air pollution at a specific monitoring site that can be compared to the NAAQS. Design Values are generally used to classify and designate non-attainment areas (EPA 2019d). The measurement parameters for each air monitor vary depending on the criteria pollutant being monitored, the scale at which that pollutant is being measured, the duration and frequency of the monitoring sample, and the monitor objective. CAA regulations establish design criteria for ambient air quality monitoring networks (also known as SLAMS, state, and local air monitoring stations), including “scales of representativeness of most interest” for monitoring sites, ranging from national and global scales down to the local level (EPA 2012).[7]

Standards for each of the criteria pollutants are measured in different ways. For instance, the ozone primary and secondary standards are set at a level of 0.070 ppm averaged over an 8-hour period. This standard is

[5] The CAA gives special protection to the air quality and visibility of Class I areas, defined as national parks larger than 6,000 acres and national wilderness areas larger than 5,000 acres that were in existence when the CAA was amended in 1977.
[6] There are three active regional air monitors in the analysis area, two in San Juan County and one in Rio Arriba County. The two monitors in San Juan County are in Chaco Culture National Historical Park and northwest of Fruitland at the 1H Substation. The air monitor at the CCNHP Repeater site is operated by the National Park Service and monitors regional levels of O_3 and NO_2. The 1H Substation is operated as part of the state air quality monitoring network overseen by the NMED and measures regional levels of O_3, NO_2, SO_2, and (recently) PM_{10}. The single active air monitor in Rio Arriba County (3CRD) is located in the Coyote Ranger District of the Santa Fe National Forest. It is operated by the NMED to monitor regional levels of O_3. Current data for active regional air monitors are used to establish background concentrations of criteria pollutants in the analysis area.
[7] For more information, see Appendix D to Part 58, available at https://www.govinfo.gov/content/pkg/CFR-2014-title40-vol6/pdf/CFR-2014-title40-vol6-part58-appD.pdf.

met when the fourth-highest daily maximum (for the 8-hour O_3 concentration) is less than or equal to 0.070 ppm when averaged over a 3-year period. The primary 1-hour standard for NO_2 is set at a level of 100 ppb over a 1-hour period. This standard is met when the 3-year average of the 98th percentile (of the 1-hour daily maximum concentration) is less than or equal to 100 ppb. **Table 3.1** summarizes the Design Value concentrations of criteria pollutants within the analysis area, compared with the NAAQS and NMAAQS. The counties in the analysis do not currently monitor for CO, Pb, or $PM_{2.5}$; however, because the counties are relatively rural in character, it is likely that concentrations of these pollutants are not elevated. While there is an installed location for PM_{10} monitoring in San Juan County, the monitor status of this station currently shows invalid data and cannot be used to represent design values.

Table 3.1 2019 Design Values in McKinley, Rio Arriba, Sandoval, and San Juan Counties

Pollutant	2019 Design Values	Averaging Time	NAAQS	NMAAQS
O_3	0.067 ppm (Rio Arriba County) 0.069 ppm (San Juan County)	8-hour	0.070 ppm[1]	–
NO_2	10 ppb (San Juan County)	Annual	53 ppb[2]	50 ppb
NO_2	34 ppb (San Juan County)	1-hour	100 ppb[3]	–
SO_2	2 ppb (San Juan County)	1-hour	75 ppb[3]	–

Source: EPA 2019d

[1] Annual fourth-highest daily maximum 8-hour concentration averaged over 3 years.

[2] Annual mean.

[3] 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years.

O_3 is the criteria pollutant that is of most concern for the analysis area. As a secondary pollutant, O_3 is not a direct emission pollutant (that is, it is not emitted directly into the air), but it is the result of chemical reactions between a group of highly reactive gases called nitrogen oxide(s) (NO_x) and volatile organic compounds (VOCs, which are organic compounds that vaporize [i.e., become a gas] at room temperature) when exposed to sunlight (EPA 2019e). O_3 and NO_2 are criteria air pollutants and are regulated under the NAAQS and NMAAQS. VOCs are not criteria pollutants, however, because O_3 is not a direct emission; emissions of NO_x (particularly NO_2, which is used as an indicator for the larger group of gases), and VOCs are used as a proxy for determining potential levels of secondary formation of O_3.

O_3 is most likely to reach unhealthy levels on hot, sunny days in urban environments and can be transported long distances by wind into rural areas (EPA 2019e). Breathing O_3 can have human health effects particularly for sensitive groups (children, the elderly, and those with chronic lung conditions like bronchitis,emphysema, and asthma). High O_3 levels can also harm sensitive vegetation (NMED 2019a). Major sources of emissions for both NO_x and VOCs include industrial facilities like power plants and motor vehicleexhaust (including off-road equipment). Biogenic sources, such as trees and plants, can also represent a substantial portion of NO_x and VOC emissions in an area, including New Mexico (BLM 2019).
NO_x is primarily emitted through fossil fuel combustion in electric utilities, high-temperature operations at other industrial sources, and the operation of motor vehicles (BLM 2019). NO_x can also react with other chemicals in the air to form particulate matter, contributing to haze (BLM 2019). VOCs are also emitted from burning fuels (gasoline, wood, coal, or natural gas) and are associated with refineries, oil and gas production equipment, and other industrial processes. VOCs are also released from chemicals like solvents, paints and thinners, adhesives, air fresheners, copy machines and printers, cleaners and disinfectants, and other consumer projects (National Institute of Health, U.S. National Library of Medicine 2017). The upstream sources of VOCs that are produced during the production of oil and gas are during the separation of gases from liquids and the storage process. Such emissions are generally controlled with the use of enclosed combustion devices, such as flares. Leaks and ineffective control systems are also a source of VOC emissions. In the event that VOCs are produced from incomplete combustion, they become more highly reactive ozone precursors (Matichuk et al. 2016

Monitoring conducted by the NMED (under the EPA) in the analysis area indicates that levels of O_3 have come close to, but have not yet, exceeded the NAAQS in San Juan County. If such exceedances were to occur, the area would be designated “nonattainment”, which could impact industrial development for the area (NMED 2019b). The Ozone Attainment Initiative is a project authorized by State Statute, 74-2-5.3 New

Mexico Statutes Annotated 1978. This statute directs the NMED to develop plans that may include regulations more stringent than federal rules for areas of the state in which ambient monitoring shows ozone levels at or above 95% of the NAAQS (NMED 2019b).

Particulate matter (also known as particle pollution) is a mixture of solid particles and liquid droplets in the air. Particulate matter varies in size: PM_{10} refers to particulate matter 10 micrometers or less in diameter (commonly considered "dust"). $PM_{2.5}$ refers to particulate matter that measures 2.5 micrometers or less (i.e., fine particles), which are the main cause of reduced visibility (haze) in the United States (EPA 2019f).The EPA regulates particulate matter 10 micrometers in diameter or smaller (PM_{10} and $PM_{2.5}$) because these smaller particles are associated with negative health effects including respiratory and cardiovascular problems and because they can become more deeply embedded into the lungs (BLM 2019) but does not regulate particles larger than 10 micrometers in diameter (such as sand and larger dust particles). $PM_{2.5}$ is not currently monitored in the analysis area, and there are no areas of high concentrations that would warrant monitoring by the NMED. Recent monitoring for PM_{10} in the analysis area began in 2017 at the 1H Substation. Like O_3, most particulate matter is formed by reactions between other chemicals, specifically between SO_2 and NO_x, which are emitted from vehicles, power plants, and other industrial processes (EPA 2019f). Particulate matter emissions often result from activities like construction, traffic on unpaved roads, fields, and wildfires (EPA 2019f). Particulate matter is of heightened concern when emissions are near sensitive receptors, such as residences, because particulate matter can be present in higher concentrationsin a localized area prior to settling or dispersion.

Criteria Pollutant Emissions

Along with criteria pollutant concentrations as measured by air monitors, the EPA provides data on human-caused criteria pollutant emissions, expressed in tons per year or total volume of pollutant released into the atmosphere. Human-caused emissions data point to which industries and/or practices are contributing the most to the general level of pollution (BLM 2019). Total human-caused emissions within the analysis area are reported in **Table 3.2** based on 2017 National Emissions Inventory (NEI) in tons per year (EPA 2017a).

These emissions are primarily the result of electrical power generation, oil and gas development, vehicles (highway and off-highway traffic), and other industrial activities (EPA 2017a). The primary sources of several criteria air pollutants in the analysis area are two coal-fired electrical generation units: The San Juan Generating Station 15 miles west of Farmington, New Mexico, and the Four Corners Power Plant on the Navajo Nation near Fruitland, New Mexico. In 2014, these electrical generation units were the primary source of SO_2 (85%), NO_x (41%), and $PM_{2.5}$ (3%) in the analysis area (BLM 2019). There have since been some changes in operations at the San Juan Generating Station (a four-unit coal-fired generator) and the Four Corners Power Plant (a five-unit coal-fueled generator) to meet the requirements of the federal regional haze rule:

- In 2016, two of the four units at the San Juan Generating Station had selective catalytic reduction technology installed to satisfy Best Available Retrofit Technology (BART) requirements from EPA (Enchant Energy 2019). The installation of selective catalytic reduction technology is estimated to result in a 67% reduction in SO_2, 62% reduction in NO_x, 50% reduction in particulate matter, 44% reduction in CO, 51% reduction in VOCs, 50% reduction in carbon dioxide (CO_2), and 50% reduction in mercury (BLM 2019). In December 2017, the two units that did not meet the BART requirements were closed. In March 2018, an explosion at one of the two remaining units rendered it inoperable (Navajo Times 2018).

- In 2013, three of the five units at the Four Corners Power Plant were shut down. In mid-2018, the two remaining units had selective catalytic reduction technology installed to satisfy BART requirements from EPA (Power Magazine 2019). It is estimated that this retrofit would result in a 36% reduction in NO_x, a 61% reduction in mercury, a 43% reduction in particulate matter, a 30% reduction in CO_2, and a 24% reduction in SO_2 (BLM 2019).

The Western States Air Resources Council-Western Regional Air Partnership (WESTAR-WRAP) conducted an oil and gas emissions inventory report for base year 2014 to further clarify the contributions of oil and gas activities to human-caused emissions within the Permian and San Juan Basins. The results

indicate there are non-point sources, including fugitive components, pneumatic devices, pumps, and well blowdown events that may not be reported through the state and federal inventories. These nonpoint sources could represent greater criteria, hazardous air pollutants (HAPs), and GHG emissions within these basins, in particular VOC and NO_x emissions that contribute to ozone formation. It is therefore believed that the NEI (EPA 2017a) data in **Table 3.2** related to petroleum and related industries are underreported in terms of VOC and NO_x emissions. **Table 3.2** provides a comparison of the NEI and WESTAR-WRAP data sets. As shown in the table, a comparison of data sets indicates that oil and gas development–related NO_x and VOC emissions may be underreported by approximately 23.0% and 41.4%, respectively.

Table 3.2 Human-Caused Emissions in the Analysis Area, in Tons per Year

Rio Arriba and San Juan Counties	NO_X	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2
2017 NEI—all sources	52,019	161,261	97,047	33,031	13,039	5,576
2017 NEI—petroleum and related industries	23,385	–	67,837	–	–	–
WESTAR-WRAP 2014 oil and gas sources	30,351	–	115,793	–	–	–

Notes: Biogenic sources are not included. Only precursor pollutants to ozone formation compared in this analysis (NO_x and VOC). Values may not always match those above if queried on demand as the NEI database updates its emissions periodically with newer emission information.

Sources: EPA 2017a; Ramboll Environ 2017

Air Quality Index

Air quality in a given region can also be measured by its Air Quality Index (AQI) value. The AQI is used to report daily air quality information in an easy-to-understand way by explaining how local air quality relates to human health. Calculated by the EPA, the AQI considers the following: O_3, particulate matter ($PM_{2.5}$ and PM_{10}), NO_2, SO_2, and CO (all except Pb). According to the EPA, O_3 and particulate matter, both calculated daily for the AQI, are the two air pollutants that pose the greatest threat to human health (EPA 2019g).

The AQI translates daily air quality data into a tiered, color-coded system that helps people understand how clean outdoor air is, who may be affected if pollutant levels are higher than desired, and when individuals may want to take measures to protect their own health. The higher the AQI value, the greater the level of air pollution and the greater the concern for public health. An AQI value of 100 typically corresponds to the NAAQS set for that pollutant, and values below 100 are considered satisfactory for public health. **Table 3.3** presents the AQI values (with associated color category) and levels of health concern.

Table 3.3 Air Quality Index

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

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

Source: EPA 2019g

The AQI summary report (EPA 2019g) provides annual summary information, including maximum AQI values and count of days in each AQI category. **Table 3.4** lists the number of days in which the AQI was "unhealthy for sensitive groups" or worse for the past 10 years. With the exception of 2018, San Juan County shows a general decreasing trend in number of days classified above 100 AQI. Rio Arriba County shows no significant trend.

Table 3.4 AQI Summary Data for Number of Days Classified above 100 for the Analysis Area(2010–2019)

Location	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Rio Arriba County	0	0	0	2	0	0	0	3	3	0
San Juan County	20†	18	12	6‡	0	2	2	6	16	0
Sandoval	0	0	0	0	0	0	0	1	12	0
McKinley	0	0	0	0	-	-	-	-	-	-

Source: EPA 2019g

Note: All AQI values presented are classified as unhealthy for sensitive groups (101–150), unless otherwise indicated. Annual summary data for McKinley County are only available for 2008–2013.

† Including five (5) unhealthy days (above 150) and two (2) very unhealthy days (above 200).

‡ Including one (1) unhealthy day (above 150).

Hazardous Air Pollutants

The CAA requires control measures for hazardous air pollutants (also known as HAPs or air toxics), which are a class of 187 toxic air pollutants that are known or suspected to cause cancer or other serious health effects and/or adverse environmental effects. National Emission Standards for Hazardous Air Pollutants (NESHAPs), established by the EPA, limit the release of specified HAPs from specific industries (BLM 2019). NESHAPs for oil and gas development include control of benzene, toluene, ethyl benzene, mixed xylenes, and n-hexane from major point sources, and benzene emissions from triethylene glycol dehydration units as area sources (BLM 2019). The CAA defines a major source for HAPs as being one that emits 10 tons per year of any single HAP or 25 tons per year of any combination of HAPs. Under state regulations, a construction or operating permit may be required for a major source and for New Mexico, determining a major source requires consideration of each oil and gas exploration and production well individually (BLM 2019). In New Mexico, regulations for major sources are found under NMAC 20.2.70 and 20.2.71.

The Air Resources Technical Report discusses the relevance of HAPs to oil and gas development and the particular HAPs that are regulated in relation to these activities (BLM 2019). The National Air Toxics Assessment (NATA), published by the EPA, provides a tool to help focus emissions reductions strategies. The most recent NATA was completed for 2014 and was released in August 2018 (EPA 2014). The 2014 NATA models ambient concentrations and estimates exposures and risk of cancer and/or other health impacts from HAPs, represented as risk hazard indices for cancer, neurological problems, and respiratory problems for each county and census tract (BLM 2019). NATA cannot give precise exposures and risks for a specific individual; therefore, NATA data are best applied to larger areas. NATA derives concentration and risk estimates from emissions data from a single year and assumes a person breathes these emissions each year over a lifetime (approximately 70 years). Lastly, NATA only considers health impacts from breathing air toxics and does not take into account indoor hazards, contacting or ingesting these air toxics, or other ways in which people may be exposed (BLM 2019). A review of the results of the 2014 NATA shows that cancer, neurological risks, and respiratory risks in the analysis area are generally lower than national levels of 31.7 cases per 1 million people. The 2014 NATA map application reveals that the average cancer risk index (defined as the probability of contracting cancer over the course of a lifetime [70 years], assuming continuous exposure) from human-caused emissions of HAPs in the analysis area is approximately 19 (that is 19 cases per 1 million people). The total cancer risk is 14 and 24 for Rio Arriba and San Juan Counties, respectively (EPA 2014).

Air Quality Related Values

The primary AQRVs of concern in the study area are visibility and acid deposition. EPA monitors visibility and acid deposition at national parks, national monuments, and other locations where AQRVs are of concern. EPA monitors visibility at national parks through its Interagency Monitoring of Protected Visual Environments (IMPROVE) Program. The IMPROVE stations nearest to the Mancos-Gallup RMPA Planning Area are located at Mesa Verde National Park, Weminuche Wilderness, San Pedro Parks Wilderness, and Bandelier National Monument. There has been a slight improvement in visibility on the 20 percent clearest days at all four monitoring stations since the early 2000s. Similarly, there has been a slightly improving trend in visibility on the 20 percent haziest days over this period. (BLM 2019). EPA monitors deposition of air pollutants at national parks through its Clean Air Status and Trends Network (CASTNET) program. The CASTNET station nearest to the Mancos-Gallup RMPA Planning Area is located at Mesa Verde National Park. Both nitrogen and sulfur deposition rates at this site have shown a downward trend since monitoring began in 1995 (BLM 2019).

3.2.2 Environmental Impacts – No Action Alternative

Under the No Action Alternative, the FIMO would not sell the proposed lease parcels. Production in the area would continue at its current rate, and other current land use in the area would continue. No resulting impact to air quality or increases in fugitive dust would occur.

3.2.3 Environmental Impacts – Proposed Action

Methodology and Assumptions

Emissions estimates for construction, operations, maintenance, and reclamation for a one-well horizontal and oil gas well on federal lands are included in **Table 3.5** and **Table 3.6**. Construction emissions for both an oil and gas well include well pad construction (fugitive dust), heavy equipment combustive emissions, commuting vehicles, and wind erosion. Operations emissions for an oil well include well workoveroperations (exhaust and fugitive dust), well site visits for inspection and repair, recompletion traffic, water and oil tank traffic, venting, compression and well pumps, dehydrators, and compression station fugitives. Operations emissions for a gas well include well workover operations (exhaust and fugitive dust), wellhead and compressor station fugitives, well site visits for inspection and repair, recompletions, compression, dehydrators, and compression station fugitives. Maintenance emissions for both oil and gas wells are for road travel, and reclamation emission activities are for interim and final activities and include truck traffic, a dozer, blade, and track hoe equipment.

Emissions for vertical wells are analyzed as a horizontal well due to current predominant technological drilling methods being horizontal. Additionally, horizontal oil and gas wells emissions estimates represent a more conservative summary of emissions when compared to emissions from a vertical well, with the exception of SO_2, which could be four to five times greater in a vertical well scenario. However, SO_2 emissions are still estimated to be within the same magnitude and less than 1 ton per year of SO_2 emissions per well (BLM 2019).

Table 3.5 Emission Estimates for One Horizontal Oil Well

Activity/Phase	Annual Emissions (tons)[1]						
	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC[2]	HAPs
Construction	2.41	0.49	5.21	0.11	1.44	0.42	0.42
Operations	2.90	0.33	0.80	0.00	1.11	0.75	0.75
Maintenance	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Reclamation	0.00	0.00	0.18	0.00	0.08	0.00	0.00

Total	**5.31**	**0.81**	**6.19**	**0.11**	**2.63**	**1.17**	**1.17**

Source: BLM 2019.

[1] Values where a "0.00" appear may be too small and not appear due to rounding. CO_2e emissions are presented in metric tons.

[2] VOC emissions at the operational phase represent uncontrolled emission rates and estimate potential emissions representing the contribution for "one oil well" from the emissions at storage tanks, gathering facilities, etc.

Table 3.6 Emission Estimates for One Horizontal Gas Well

Activity/Phase	Annual Emissions (tons)[1]						
	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC[2]	HAPs
Construction	0.64	0.31	5.18	0.11	1.41	0.61	0.41
Operations	0.28	0.18	0.34	0.00	0.46	0.16	0.18
Maintenance	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Reclamation	0.00	0.00	0.18	0.00	0.08	0.00	0.00
Total	**0.92**	**0.49**	**5.71**	**0.11**	**1.95**	**0.77**	**0.59**

Source: BLM 2019.

[1] Values where a "0.00" appear may be too small to appear due to rounding. CO_2e emissions are presented in metric tons.

The methodology and assumptions for calculating air pollutant emissions and developing inputs for the calculators are further described in the Air Resources Technical Report (BLM 2019). Emissions calculators were developed by air quality specialists at the BLM National Operations Center in Denver, Colorado, and account for a number of variables, including access and construction requirements, equipment, and other infrastructure needs, as well as expected production volumes. Because these calculators quantify emissions based on averages and several assumptions (e.g., construction methods, all wells would be hydraulically fractured), these estimates provide approximations of emissions of criteria pollutants, VOCs, and HAPs relative to regional and national levels. Additionally, the BLM in New Mexico has modified the calculators and assumptions for use in analyzing a single well to more closely represent oil and gas wells in the state and to address emissions from development and production for one horizontal well (BLM 2019). Emissions estimates per well are included in **Table 3.5** and **Table 3.6**.

Impacts Analysis

Future potential development of the lease parcels would include increased criteria pollutant emissions, including increased particulate matter released from new well pads or roads, exhaust emissions from drilling equipment, compressor engines, vehicles, flares, dehydration and separation facilities, and VOCs during drilling and production activities. As stated above, the most substantial criteria pollutants and ozone precursors emitted by oil and gas development and production are VOCs, particulate matter, and NO_2.

Future potential development on the lease parcels is estimated at approximately forty-nine horizontal wells and two vertical wells across all lease parcels (see **Table 2.1** for a listing of the number and type of wells anticipated per parcel). This analysis assumes that all parcels would be developed concurrently. This assumption facilitates quantification in the analysis and provides a conservative (high) estimate of maximum concurrent emissions as a result of leasing and future potential development of the lease parcels. While emissions under the Proposed Action reported in **Table 3.7** remain a reasonable estimate of total emissions from future potential development, it is more likely that lease development activities and emissions would be spread out over time as a result of the varying development plans and approaches of lessees in the context of overall oil and gas development throughout the analysis area. Some parcels may not develop atall. This is supported by information contained under Greenhouse Gases and Climate Change section, **Table 3.11**, which shows that over the last 7 years, the FFO has averaged 39 well completions annually. Note also that the RFD (of which the Proposed Action is a part), assumes development of 99 federal wellsannually (see the Air Resources Reasonably Foreseeable Future Actions section, **Table 3.9**).

Table 3.7 Percent Emissions Increase from Future Potential Development of the Lease Parcels

	Lease Reinstatement Emissions (tons per year)						
	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	HAP[2]
Human-caused current emissions (San Juan Basin [San Juan, McKinley, Rio Arriba, and Sandoval Counties])	33,031	13,039	52,019	5,576	161,261	97,047	12,114
One oil-well emission factors[1] (22 Wells)	5.31	0.81	6.19	0.11	2.63	1.17[3]	1.17
One gas-well emission factors[1] (29 Wells)	0.92	0.49	5.71	0.11	1.95	0.77	0.59
Total emissions from lease Sale (Fifty-One wells)	143.5	32.03	301.77	5.61	100.76	48.07	42.85
Percent increase	0.4%	0.2%	0.6%	0.1%	0.06%	0.05%	0.4%

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

[2] Source: EPA 2017a

[3] VOC emissions at the operational phase represent uncontrolled emissions and estimate potential emissions representing the contribution for "one oil well" from the emissions at storage tanks, gathering facilities, etc. However, federally enforceable regulations such as New Source Performance Standards (NSPS) OOOO and OOOOa both require emission reduction of VOC by 95%from well completions following hydraulic fracturing or refracturing and storage tanks with emissions greater than 6 tons per year after federally enforceable controls. Therefore, actual emissions from the one well scenario are likely be lower than represented.

As shown in **Table 3.7**, emissions associated with concurrent development of fifty-one wells would range from 0.06% increase in CO to a 0.5% increase in NO_x for the entire region. Emissions are anticipated to be at their highest level during the construction and completion phases (approximately 30 days in duration) because these phases require the highest degree of earth-moving activity, heavy equipment use, and truck traffic, compared with the operations and maintenance phases. Emissions are anticipated to decline during operations and maintenance as the need for earth-moving and heavy equipment declines.

VOCs and NO_2 contribute to the formation of O_3, which is the pollutant of most concern in northwestern New Mexico and because O_3 is not a direct emission, emissions of NO_x and VOCs are used as proxies for estimating O_3 levels. Under the Proposed Action, the additional NO_2 and VOCs from each of the fifty-one wells would incrementally add to O_3 levels within the analysis area. However, as noted above, all fifty-one wells would not necessarily be developed concurrently or even in a single year. Additionally, emissions would be spread out spatially because the lease parcels are located in San Juan and Sandoval Counties. Thus, given the spatial distribution and the small overall number of wells to be developed as part of the Proposed Action, it is not expected that the Proposed Action would lead to a violation of the O_3 NAAQS standard in either county. The Proposed Action is estimated to result in up to 1.17 tons per year of HAP emissions from combined construction and operation of each well during the first year, which would be the maximum annual rate of HAP emissions. The Clean Air Act defines a major source for HAPs to be one emitting 10 tons per year of any single HAP or 25 tons per year of any combination of HAPs (BLM 2019). Because this is prior to implementation of any applicable federally enforceable controls, this represents a conservatively high estimate of potential HAP emissions. Therefore, it is not expected that the Proposed Action would be a major source of HAP emissions.

Under the Proposed Action, particulate matter emissions (PM_{10} and $PM_{2.5}$) would both increase by 0.4% and 0.2%. One of the primary sources of particulate matter emissions would be from construction on the lease parcels where dust and fine particulates are generated by on-site equipment and activities, as well

as off-site vehicles (Araújo et al. 2014; Reid et al. 2010). How particulate matter interacts with the environment is dependent on a variety of factors, with the size and chemical composition of the airborne particles being the most important in terms of dispersion (distance from the source) and deposition from the atmosphere. Impacts of particulate matter emissions would not be confined to the construction site because $PM_{2.5}$ (fine particles) can travel farther in terms of distance than PM_{10} (dust) and other total suspended particulates (particles of sizes up to 50 micrometers) and therefore can impact residents in the surrounding area (Araújo et al. 2014). There are high potentials to HAP as there are ten (10) parcels that have structured homes in close proximity and three (3) parcels that have structured homes within 1 mile of the lease sale parcels. The Proposed Action may also result in localized impacts on air quality for nearby residences from emissions of criteria air pollutants (CAPS), VOCs, and HAPs. A significant portion of the criteria pollutants, VOCs, and HAP emissions would be from construction and completion on the lease parcels, the Proposed Action would result in short-term increases in these emissions, lasting an average of 30 days. As stated above, air quality is dependent not only on the quantity of air pollutants, but also environmental conditions (humidity, wind direction and speed, temperature) that influence concentration and/or dispersion of pollutants. Ongoing operations of the well site would be subject to state and federal permitting (unless emissions are less than the state and federal thresholds for permitting), recordkeeping, monitoring, and reporting requirements which ensure compliance with air quality emission standards.

Levels of HAPs would also temporarily increase during construction and completion activities under the Proposed Action, particularly in the form of diesel particulate matter from the on- and off-road construction equipment. Concentrations of mobile source emissions of diesel particulate matter are typically reduced by 60% at a distance of approximately 300 feet (Zhu et al. 2002). The relatively steep drop-off with distance of diesel particulate matter concentrations as well as the short duration of the activity make the impacts from exposure to HAP emissions minimal during construction. Additionally, HAP emissions from ongoing operations would be minimal on a per-well basis (1.17 ton per year per well). Compliance with State, Federal and Navajo Nation permitting requirements are designed to ensure that a proposed source will not cause or contribute to a violation of NAAQS standards

3.2.4 Cumulative Impacts

Past and Present Actions

Current estimated emissions across the two-county analysis area are reported above and air quality across the analysis area is generally good based on AQI ratings over the last decade (see **Table 3.4**). Current estimated emissions and AQI ratings are reflective of the effects of past and present actions. Power generation is a major source of regional air emissions. Two major sources of criteria pollutant and VOC emissions are the San Juan Generating Station and the Four Corners Power Plant (BLM 2019); however, the 2017 shutdown of two of the four units at the San Juan Generating Station and the 2016 and 2018 retrofitting of the remaining units both at the San Juan Generating Station and Four Corners Power Plant are expected to decrease emissions substantially (see the Affected Environment section under *Criteria Pollutant Emissions*).

Oil and gas development is a prominent source of emissions. There are approximately 23,034 active oil and gas wells in the counties within the Mancos-Gallup planning area, which includes Rio Arriba, San Juan, Sandoval, and McKinley counties. About 16,139 of the wells in these counties are federal wells, with the remainder falling in other jurisdictions (BLM 2019). Between 2014 – 2020, there have been a total of 273 federal well completions, all of which occurred within the FFO (**Table 3.8**).

Table 3.8 Past and Present Federal Well Completions

Number of Federal Well Completions	2014	2015	2016	2017	2018	2019	2020
BLM Mancos-Gallup planning area	94	71	15	30	36	18	9

Reasonably Foreseeable Future Actions

Continued oil and gas development is a prominent reasonably foreseeable future action affecting air quality in the analysis area, and the May 2018 Mancos-Gallup RFD Scenario estimates that there could be an

additional 3,200 wells drilled within the analysis area by 2037 (Crocker and Glover 201), or about 160 wells per year. Note this includes both federal and non-federal well development; the federal component of the RFD scenario would be 1,980 wells or 99 wells per year. Annual well averages are multiplied by the one-gas well pollutant emission factor to calculate RFFA annual emissions for both federal well development and federal and non-federal well development associated with the RFD scenario in Year 2020 (**Table 3.9**). The emissions are a combination of HAP constituents existing in natural gas and released during the completion and operation process. Most gas vented during the completion process is flared, which substantially reduces the quantity of HAPs released.

PNM announced its intent to close the San Juan Generating Station in 2022, when the coal supply agreement expires. However, the City of Farmington has indicated interest in retaining ownership post-2022 and has teamed with Enchant Energy to repurpose the San Juan Generating Station into a commercial-scale carbon-capture utilization and sequestration facility and wholesale power generator (Enchant Energy 2019). A July 2019 pre-feasibility study recommended development of a more in-depth front-end engineering and design study (Sargent and Lundy 2019). The Los Alamos National Laboratory found the proposed plan to be technically viable and concluded that there was sufficient demand for the project (Los Alamos National Laboratory 2019). Given the uncertainties around this project, expected reductions in emissions from potential future development of a carbon-capture facility are not included in the cumulative impact emissions disclosed below.

The NMED Air Quality Bureau has begun developing an Ozone Attainment Initiative to set standards for emission sources that contribute to the exceedance of design values of 95% or more, to control NO_x and VOCs to achieve maintenance or attainment of the standards pursuant to New Mexico Statutes 74-2-5.3 (NMED 2019b).

Table 3.9 Air Emission from Annual Oil and Gas Well Development Associated with the RFD Scenario

	Lease Reinstatement Emissions (tons per year)						
	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	HAPs
Human-caused emissions (Sandoval, McKinley, Rio Arriba, and San Juan Counties)	33,031	13,039	52,019	5,576	161,261	97,047	12,114
One oil-well emission factor[1]	5.31	0.81	6.19	0.11	2.63	1.17[2]	1.17
One gas-well emission factor	0.92	0.49	5.71	0.11	1.95	0.77	0.59
Total annual emissions for annual reasonably foreseeable federal well development (99 wells)	525.69	80.19	612.81	10.89	260.37	115.83	115.83
Percent increase	1.59%	0.62%	1.18%	0.2%	0.16%	0.12%	0.96%
Total annual emissions for annual reasonably foreseeable federal and non-federal well development (160 wells)	849.6	129.6	990.4	17.6	420.8	187.2	187.2
Percent increase	2.6%	0.99%	1.9%	0.32%	0.26%	0.19%	1.55%

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

[2] VOC emissions at the operational phase represent uncontrolled emissions and estimate potential emissions representing the contribution for "one oil well" from the emissions at storage tanks, gathering facilities, etc. However, federally enforceable regulations such as NSPS OOOO and OOOOa both require emission reduction of VOC by 95% from well completions following hydraulic fracturing or refracturing and storage tanks with emissions greater than 6 tons per year after federally enforceable controls. Therefore, actual emissions from the one well scenario are likely be lower than represented.

Cumulative Impact Analysis

The future potential development of the lease parcels associated with the Proposed Action comprises less than 1.6% of the RFD scenario (3,200 wells) and assuming concurrent development, would be 31.9% of annual reasonably foreseeable development (160 wells). However, as noted above, it is uncertain whether the forty-nine horizontal wells and two vertical wells under the Proposed Action would be developed concurrently or even in a single year. When combined with the impacts of past, present, and reasonably foreseeable future actions, the future potential development of the lease parcels under the Proposed Action would incrementally contribute to cumulative increases in air quality emissions, with cumulative increases in criteria pollutants between 0.19% to 2.6% of existing annual emissions of all well development, federal and non-federal (see **Table 3.9**). As with the Proposed Action, emissions are anticipated to be greatest during the construction and completion phases. Localized and short-term impacts on air quality at nearby residences from emissions of particulate matter, NOx, VOCs, and HAPs are expected; however, because well development varies (i.e., permit approval, well pad construction, spudding, and completion), the phases of development may not occur in succession but may be spread out in development over time. As such, the incremental addition of criteria pollutants and VOCs would not be expected to result in any exceedances of the NAAQS or NMAAQS for any criteria pollutants in the analysis area.

3.2.5 Mitigation Measures and Residual Effects

Additional measures taken to comply with recent revisions to the EPA's Regional Haze Rule in January 2017 would further reduce pollutant emissions. The State of New Mexico will have to comply with these revisions as it develops its State Implementation Plan for the second planning period (BLM 2019). Emissions may also be reduced through the Ozone Attainment Initiative.

The EPA has promulgated air quality regulations for completion of hydraulically fractured gas wells. These rules require air pollution mitigation measures that reduce the emissions of VOCs during gas well completions. Based on its authority under the standard terms and conditions, the BLM requires industry to incorporate and implement best management practices, which are designed to reduce impacts on air quality by reducing emissions, surface disturbances, and dust from field production and operations. Typical measures include requirements for watering dirt roads or applying magnesium chloride dust suppressantson dirt roads during periods of high use to reduce fugitive dust emissions of PM_{10} (Intermountain Oil and Gas BMP Project 2013); colocation of wells and production facilities to reduce new surface disturbance; implementation of directional and horizontal drilling and completion technologies whereby one well provides access to petroleum resources that would normally require the drilling of several vertical wellbores; suggestions that vapor recovery systems be maintained and functional in areas where petroleum liquids are stored; and performing interim reclamation to revegetate areas not required for production facilities andreduce the amount of fugitive dust.

In addition, the BLM encourages industry to participate in the Natural Gas STAR program, administered by the EPA. The Natural Gas STAR program is a flexible, voluntary partnership that encourages oil and natural gas companies to adopt proven, cost-effective technologies and practices that improve operational efficiency and reduce natural gas emissions (EPA 2006).

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

NO_x reductions can include several control measures from oil and gas–related point sources. One such measure is selective catalytic reduction (SCR) for natural gas compressors. This control is the reduction of NO_x through add-on controls. SCR controls are post-combustion control technologies based on the chemical reduction of nitrogen oxides (NO_x) into molecular nitrogen (N_2) and water vapor (H_2O). The SCR utilizes a catalyst to increase the NO_x removal efficiency, which allows the process to occur at lower

temperatures. This control applies to compressors used in natural gas production operations, natural gas–fired and process gas–fired heaters with NO_x emissions greater than 10 tons per year. This method generally offers an 80% control efficiency for NO_x (EPA 2017b).

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

VOC control measures from oil and gas–related non-point sources include reducing emissions at storage tanks, use of flares, and a leak detection and repair program to capture fugitive emissions (leaks). The EPA has New Source Performance Standards (NSPS) in place, NSPS OOOO, to reduce VOCs from well completion operations and storage tanks constructed after August 23, 2011 (EPA 2017b). NSPS OOOOa requires reduction of VOCs from well completion operations and storage tanks and imposes semiannual monitoring requirements for the collection of fugitive emission components at well sites constructed after September 18, 2015. Following the 2020 amendment to OOOO and OOOOa, fugitive emissions monitoring is only required for those wells producing greater than 15 bbl per day. Other emission controls of VOCs include vapor recovery units, enclosed combustors (vapor combustion unit), and open-tipped (candlestick flares). The most desirable control method is a vapor recovery unit since this recovers the natural gas production and sends the gas to the sales line or back to the process for facility use. Finally flaring helps to reduce 98% of VOC emissions at petroleum flares (EPA 2017b).

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

3.3 Greenhouse Gases and Climate Change

How would future potential development of reinstated lease parcels contribute to GHG emissions?

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

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

Secondly, because the impacts of GHG emissions are not localized to the area where they originate and the impact of GHG emissions are inherently cumulative, the impacts of climate change are presented in the cumulative impacts section. The contribution of the Proposed Action, as well as the cumulative actions of FIMO and the BLM NMSO, are inherently included in the cumulative GHG emissions that contribute to global climate change impacts, and for completeness, the projected BLM energy leasing activities from 13

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

3.3.1 Affected Environment

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

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

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

The two primary GHGs associated with the oil and gas industry are CO_2 and CH_4. CH_4 has a GWP that is 21 to 28 times greater than the warming potential of CO_2 over a 100-year timescale (BLM 2019). Oil and gas field production activities do not substantially contribute to N_2O levels and are therefore not included in estimating potential emissions in this EA. Several different time horizons can express GWPs to fully account for the gases' ability to absorb infrared radiation (heat) over their atmospheric lifetime. The FIMO and BLM uses the 100-year time horizon since most of the climate change impacts derived from climate models are expressed toward the end of the century. Also, in accordance with international GHG reporting standards under the United Nations Framework Convention on Climate Change and to maintain consistent comparisons over the years, official GHG emission estimates for the United States are reported based on the GWP values given in the Fourth Assessment Report (AR4) of the IPCC. A more detailed discussion of climate change and the relationship of GHGs to climate change, as well as the intensity and effects at different geographic contexts (i.e., basin-specific [San Juan], New Mexico, national, and global climate), is presented in the Air Resources Technical Report (BLM 2019).

To summarize, findings indicate that warming of the climate system is unequivocal and many of the observed changes and unprecedented over decades to millennia. It is certain that global mean surface temperature has increased since the late nineteenth century, and virtually certain that maximum and minimum temperatures over land have increased on a global scale since 1950. Human influence has been detected in warming of the atmosphere and the ocean, in changes in the global water cycle, in reductions in snow and ice, in global mean sea level rise, and in changes in some climate extremes. It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-twentieth century. Additional near-term warming is inevitable due to the thermal inertia of the oceans and ongoing GHG emissions. Worldwide, 2016 total global GHG emissions were 49,358 million metric tons (MMT) of CO_2e, including land-use change and forestry (see **Table 3.19**). Energy consumption (electricity generation, manufacturing/construction, and transportation) account for roughly 30%, 12%, and 16% of total global GHG emissions, respectively (World Resources Institute 2019).

In the United States, 2018 national emissions totaled 6,677 MMT of CO_2e (see **Table 3.10**). Energy consumption (electricity production, commercial and residential, transportation, and industry) account for 27%, 12.3%, 28%, and 22% of total national GHG emissions, respectively, or 5,971 MMT (89.41%) of CO_2e. Other GHG contributions are from agriculture (9.9%) and land use and forestry (11.6%) (EPA 2020b). On a national scale, it is estimated that extraction and end-use combustion of fossil fuels produced on federal lands comprise less than 3% of global emissions and less than 20% of national emissions. In 2014, the U.S. federal lands provided 283.2 MMT of carbon storage on a national basis. U.S. federal lands sequestered an average of 195 MMT of CO_2e between 2005 and 2014, offsetting approximately 15% of the CO_2 emissions resulting from the extraction of fossil fuels on federal lands and their end use combustion (BLM 2019).

Climate change will impact regions of the United States differently, and warming would not be equally distributed. The general trend for New Mexico over the past two decades has been increasing GHG emissions, due largely to increase in coal-based electricity generation and oil and natural gas production activities. In 2014, New Mexico federal lands provided 12 MMT of carbon storage. Federal lands in New Mexico sequestered an average of 9.5 MMT of CO_2e between 2005 and 2014 (BLM 2019). Data indicate that in the region encompassing southern Colorado and New Mexico, which includes the New Mexico Portion of the San Juan Basin where the Proposed Action will occur, average temperatures rose just under 0.7 degrees Fahrenheit per decade between 1971 and 2011, which is approximately double the global rate of temperature increase. **Table 3.10** shows estimated global emissions as well as GHG emissions for the United States, New Mexico, and the major oil and gas basins of New Mexico. Emissions are expressed in MMT CO_2e.

Table 3.10 Estimated Annual GHG Emissions

Annual GHG Emissions	Million Metric Tons per Year (MMT CO_2e)	% Global Emissions	% U.S. Emissions	% New Mexico Emissions
Global emissions, all sources [1]	49,358	100%	N/A	N/A
U.S. emissions from all sources [2]	6,677	13.53%	100%	N/A
New Mexico emissions [3]	46.6	0.09%	0.70%	100%
San Juan Basin emissions [4]	23.7	0.05%	0.35%	50.84%

Note: N/A = not applicable

Sources:

[1] As cited from World Resources Institute 2019. Based on 2016 global emissions data.

[2] As cited from EPA 2020b. Based on 2016 global emissions data.

[3] EPA 2017a. State-level emission data in the table above include mobile source emission and prescribed burning emission data from EPA's 2017 National Emissions Inventory (NEI) data, which are the most recent available national emission inventory data for these area sources of GHG emissions. These area source GHG emission values are added to the most recently available data from EPA's Facility Level Information on Greenhouse Gases Tool (FLIGHT) for the 2018 reporting period. EPA's FLIGHT data include GHG emissions from large stationary sources which are required by 40 CFR 98 to report their emissions. Note that the reporting requirements of 40 CFR 98 applies only to large suppliers of GHG emitting products or facilities in certain sectors that emit more than 25,000 metric tons of CO_2e per year. Note that agricultural and land use sectors are not required to report, and the data exclude smaller stationary sources of GHG emissions. The EPA estimates that the GHG emissions reported to the EPA through the mandatory reporting program for large stationary sources encompass approximately 85% to 90% of total U.S. GHG emissions from stationary sources.

[4] NMED 2006

It is important to note that various sources of GHG emission data have various limitations and uncertainties. The data shown in **Table 3.10** include data that have been collected and verified by the EPA and the World Resources Institute, a nongovernmental organization that compiles dozens of different data sets to estimate historical GHG emission data, including from the U.S. Census Bureau, the U.S. Department of Commerce, and the EPA. However, other sources of GHG data may result in different estimates.

Global Carbon Budget Discussion

Human activities are estimated to have caused approximately 1.0°C of global warming[8] above pre-industrial levels, with a likely range of 0.8°C to 1.2°C. Global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate (high confidence) (IPCC 2018). Climate models project robust[9] differences in regional climate characteristics between present-day and global warming of 1.5°C, and between 1.5°C and 2°C. These differences include increases in the following:

- mean temperature in most land and ocean regions (high confidence),
- hot extremes (temperatures) in most inhabited regions (high confidence),
- heavy precipitation in several regions (medium confidence), and
- the probability of drought and precipitation deficits in some regions (medium confidence) (IPCC 2018).

Limiting global warming requires limiting the total cumulative global anthropogenic emissions of CO_2 since the preindustrial period, that is, staying within a total carbon budget (high confidence). Carbon budgeting, as defined by IPCC, refers to three concepts as follows:

- an assessment of carbon cycle sources and sinks on a global level,
- the estimated cumulative amount of global CO_2 emissions that is estimated to limit global surface temperatures to a given level above a reference period, and
- the distribution of the carbon budget defined under the regional, national, or sub-natural levels based on considerations of equity, cost, or efficiency (IPCC 2018).

The BLM finds that incorporating a detailed global carbon budget discussion into the greenhouse gas impact analysis for the Proposed Action is not useful as it does not provide any substantive additional information for the decision maker beyond the analysis already provided. The BLM has chosen to discuss GHG emissions as "relative magnitude of emissions" and climate change impacts using the various RCP pathways in which the model incorporates various ranges of carbon radiative forcing pathways. Climate model projections (as used in the RCP pathways) are "quite accurate" (NASA 2020) and the uncertainty in the models are not on the same scale as the uncertainty of carbon budgets. There are at least twelve carbon budget studies with estimates that focus on limiting warming to (50%, 66% probabilities, etc.) below 1.5°C and 2.0°C (Carbon Brief 2018). Some of these studies are based on Earth System Models (ESMs), some on combined observations and ESMs, and others on Integrated Assessment Models; all of which use varying degrees of interim physics dynamics and data methodologies to provide carbon budget estimates. There are sizable uncertainties reflected in these estimates as many different approaches are modeled into these carbon budget estimates. Some studies even show that the global carbon budget to limit warming below 1.5°C has already been expended. Attempting to show the relationship between a carbon budget and warming trends is not direct and linear and can vary drastically based on the following large uncertainties:

[8] Present level of global warming is defined as the average of a 30-year period centered on 2017 assuming the recent rate of warming continues.

[9] Robust is here used to mean that at least two thirds of climate models show the same sign of changes at the grid point scale, and that differences in large regions are statistically significant.

- disagreement about what “surface temperature” refers to,
- the definition of the “pre-industrial” period,
- what observational temperature datasets should be used,
- what happens to non-CO_2 factors that influence the climate, and
- whether Earth-system feedbacks like thawing permafrost are considered.

Drastic changes can also occur when there are net-negative emissions or depending on how quickly climate-cooling aerosols are reduced (Carbon Brief 2018). While levels of uncertainly are not uncommon to scientific projections, the challenge with carbon budgets is not that there is uncertainty in the budget but rather that the uncertainty is “substantial” as identified by the IPCC (IPCC 2018). A brief simulation of why using the carbon budget is not useful for purposes of NEPA disclosure and impact analysis is illustrated here. Using the global mean surface air temperature, as in IPCC’s AR5, an estimate of 580 gigatons (Gt) CO_2, is used as the 2018 baseline for the remaining carbon budget to limit warming to 1.5°C with a 50% probability, through 2100. While these estimates can be used as a baseline, “substantial” uncertainty exists (IPCC 2018). The IPCC 2018 Special Report states that the following uncertainties exist:

- the climate response from CO_2 and non-CO_2 emissions is ± 400 Gt CO_2,
- the level of historic warming contributes ±250 Gt CO_2 of uncertainty,
- potential additional carbon release from future permafrost thawing and methane release from wetlands would reduce budgets by up to 100 Gt CO_2, and
- another ±250 Gt CO_2 from future non-CO_2 mitigation efforts.

These uncertainty totals for the 50% probability budget of 580 Gt CO_2 for 1.5℃, could mean that the budget has already been expended by 1,000 Gt CO_2, or is up to 900 Gt CO_2 larger. Due to this substantial level of uncertainty the carbon budget approach to contextualizing the GHG emissions associated with future potential development of the nominated lease parcels is not any more useful to the decision maker than the relative magnitude of emissions approach the BLM already employs.

Recent studies have identified anomalously large methane (CH_4) concentrations (a “hotspot”) in the Four Corners region including the northern portion of the FFO. A subsequent study also indicated larger anomalies over other oil and gas basins in the United States. While space-borne studies can determine the pollutant concentration in a column of air, these studies cannot pinpoint the specific sources of air pollution. Further study is required to determine the sources responsible for methane concentrations in the Four Corners region; however, it is known that a significant amount of methane is emitted during oil and gas well completion. Methane is also emitted from process equipment, such as pneumatic controllers and liquid unloading at oil and gas production sites (BLM 2019).

A 2015 study identified more than 250 individual sources of methane; observed sources from included gas processing facilities, storage tanks, pipeline leaks, and well pads, as well as a coal mine venting shaft (Frankenberg et al. 2016). Information on methane may also be found in a new interactive mapping tool launched by NMED in 2019. The mapping tool shows elevated methane levels along the northern border of San Juan County and western border of Rio Arriba County, New Mexico. It also provides locations of NMED-permitted oil and gas wells and tank batteries for permits greater than 10 tons of methane emissions per year. These sources are concentrated along State Route 550 in San Juan, Rio Arriba, and Sandoval Counties, northeast of CCNHP (NMED 2019c). Quantifiable sources of methane emissions contributing to the Four Corners region methane hotspot include large, stationary sources (such as gas processing facilities) subject to the EPA’s Mandatory Greenhouse Gas reporting requirements codified in 40 CFR Part 98. Emissions from these sources are included in the EPA’s Facility Level Information on Green House Gas Tool (FLIGHT) data (EPA 2019i) which is summarized in **Table 3.10**. However, it is important to note that emissions of other potential contributors to this hotspot, such as unplanned methane releases (leaks and seepages) or smaller sources not subject to mandatory reporting thresholds are not included in these data.

- San Juan Basin CH4 regional hotspot is an example of night-time/early morning emissions trapping in a topographical basin with “known” CH4 sources.

- Methane and NMHCs accumulate at night and early morning in low-lying areas

- Different sources have different emission compositions esp. different ethane to methane slopes

- Having representative emission composition data is useful!

- Aircraft survey data analysis show: 75% (85%) of detected CH4 (C2H6) plumes were over NM

- 75% of hotspot (and emissions) is attributed to natural gas and CBM operations.

3.3.2 Environmental Impacts

The following analyses quantifies emissions associated with lease parcel development (i.e., construction and operation of the forty-nine horizontal wells and two vertical wells predicted for the lease sale) and discloses the contribution of these emissions in relation to basin, state, national, and global emissions. The analysis also discloses production (downstream or end use) emissions, which are based on projected oil and gas production volumes. FIMO does not direct or regulate the end use of produced oil and/or gas. The Proposed Action’s GHG emissions contribute to GHG concentrations in the atmosphere, which cumulatively result in climate change impacts. The impacts of climate change on the analysis area are inherently cumulative and are discussed in the cumulative climate change impacts section.

Well Development (Construction and Operations)

Appendix B describes the phases associated with oil and gas development. As noted in the appendix, oil, and gas well development includes construction of the well pad, roads, and infrastructure; well drilling; and completion, which could include venting or flaring of gas. Based on experience, the BLM has determined that in the FFO, construction of an oil well would result in a total of 523.31 metric tons CO_2e; and construction of a gas well would result in a total of 1,021.59 metric tons CO_2e, FIMO has adopted these numbers for this lease sale analyses. The emissions difference between well types is largely associated with the need to vent during the well completion stage. Emission activities from operations include well workover operations, well site visits for inspection and repair, recompletion traffic, water and oil tank traffic, venting, compression and well pumps, dehydrators, and compression station fugitives. Operation of an oil well in the FFO is estimated to result in 324.99 metric tons CO_2e annually; operation of a gas well would result in 93.68 metric tons CO_2e annually.

Table 3.11 presents annual emissions associated with historical federal well completions. Between 2014 and 2020, there were a total of 273 new federal well completions in the Mancos-Gallup planning area. In 2014, as many as 94 wells were completed, while in 2016, only 15 wells were completed (BLM 2019). Over this 7-year period, there has been an average of 39 well completions, resulting in approximately 39,842.01 metric tons CO_2e.

Table 3.11 Historical Oil and Gas Well Completions in the Mancos-Gallup Planning Area

Number of Well Completions	2014	2015	2016	2017	2018	2019	2020	7-year average
Farmington Field Office	94	71	15	30	33	18	9	39
Metric tons CO_2e/year	126,579	95,607	20,199	40,397	44,437	18,389	9,194	39,842

Note: Totals calculated using an emissions factor of 1,021.59 metric tons CO_2e for construction and 324.99 metric tons CO_2e for operations (the higher of the emissions estimates identified by BLM for oil and gas wells in the FFO) as a conservative estimate of emissions. Gas wells are estimated to have higher construction and annual operational emissions, so both annual emission rates as well as total life-cycle emissions are higher for gas wells than for oil wells.

Table 3.12 presents GHG emissions associated with lease development assuming full development of the lease parcels (forty-nine horizontal wells and two vertical wells). Because it is not yet known whether the wells would be oil or gas, the higher of the emissions estimates described above are used in the analysis.

As shown in **Table 3.12**, average annual GHG emissions over the last 7 years in the BLM FFO (which includes the oil and gas development associated with the New Mexico portion of the San Juan Basin) comprised about 0.00008% of global GHG emissions, 0.0006% of U.S. GHG emissions, 0.09% of New Mexico GHG emissions, and 0.17% of San Juan Basin GHG emissions. The future potential development of forty-nine horizontal wells and two vertical wells on the lease parcels would result in the following emissions:

- Construction: up to 52,101 metric tons CO_2e (0.0001% of global GHG emissions, 0.0008% of U.S. GHG emissions, 0.1% of New Mexico GHG emissions, and 0.2% of San Juan Basin GHG emissions), which would occur in year 1 only.
- Operations: up to 16,575 metric tons CO_2e (0.00003% of global GHG emissions, 0.0002% of U.S. GHG emissions, 0.04% of New Mexico GHG emissions and 0.07% of San Juan Basin GHG emissions), which would occur each year the well is in operation.

Table 3.12 Estimated Annual GHG Emissions from Future Potential Well Development of the Leases (Construction and Operations)

Annual GHG Emissions	Metric Tons (CO_2e)[1]	Global Emissions[2] (%)	U.S. Emissions[2] (%)	New Mexico Emissions[3] (%)	San Juan Basin emissions[4] (%)
Potential GHG emissions from well construction fifty-one wells, year 1 only)	52,101	0.0001%	0.0008%	0.1%	0.2%
Potential GHG emissions from well operation (fifty-one wells) per year	16,575	0.00003%	0.0002%	0.04%	0.07%
Total	**68,676**	**0.00007%**	**0.001%**	**0.15%**	**0.3%**
Average GHG emissions 2014–2020 Mancos-Gallup Planning Area (39 wells)	39,842	0.00008%	0.0006%	0.09%	0.17%

Note: Totals may not sum exactly due to rounding.

[1] Totals calculated using an emissions factor of 1,021.59 metric tons CO_2e for construction and 324.99 metric tons CO_2e for operations (the higher of the emissions estimates identified by BLM for oil and gas wells) because the type of well is not known. Gas wells are estimated to have higher construction and annual operational emissions, so both annual emission rates as well as total life-cycle emissions are higher for gas wells than for oil wells.

[2] As cited from EPA 2020b. Based on 2018 emissions data.

[3] 2017 EPA NEI data and 2018 EPA Greenhouse Gas Reporting Program emissions; see EPA 2017a and EPA 2020b.

[4] NMED 2006

Considered together, construction and operations of forty-nine horizontal wells and two vertical wells would result in 68,676 metric tons CO_2e annually (0.0001% of global GHG emissions, 0.001% U.S. GHG emissions, 0.15% of New Mexico GHG emissions, and 0.3% of San Juan Basin GHG emissions [see **Table 3.12**]). Note that this total is a maximum development scenario that assumes that 1) all wells would be constructed in the same year, and that 2) operations would commence in the same year as construction. Lease development activities and emissions may be spread out over time as a result of the varying development plans and approaches of lessees in the context of overall oil and gas development throughout the analysis area, and some parcels may be not developed at all. If construction is spread out over multiple years, annual GHG emissions during those years would be lower than the total of 68,676 metric tons CO_2e that is reported in **Table 3.12** but higher than the operations subtotal of 16,575 metric tons CO_2e. Over the life of the forty-nine horizontal wells and two vertical wells, the total emissions from combined construction (during the first year) and operation over the 20-year time frame set forth in the RFDs would be 68,676 metric tons CO_2e. This estimate is based on all forty-nine horizontal wells and the two vertical wells being gas wells, which have a higher life-cycle emission total than oil wells.

Production (Downstream/End Use)

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

Estimated downstream/end use GHG emissions from future potential development of the lease parcels are summarized in **Table 3.13**. The analysis uses the total oil and gas production values summarized in **Table 2.1**, (5,986,000 bbl of oil and 94,024,000 mcf of natural gas) and the EPA's GHG equivalencies calculator (EPA 2019j). As noted previously, the FIMO does not direct or regulate the end use of produced oil and/or gas. The downstream/end-use GHG emissions in **Table 3.13** cannot be reasonably compared to an annual metric or value because the amount of production expected from each well on an annual basis is not known; however, **Table 3.14** provides historical production values at different scales of end-use. As another point of comparison, in 2014, end-use combustion emissions from fossil fuels produced on U.S. federal lands was 1,201 MMT and end-use combustion emissions of fossil fuels produced on New Mexico federal lands was 73 MMT (BLM 2019).

Table 3.13 Estimated Production (Downstream/End-Use) GHG Emissions for the Proposed Action

Product Category	Emission Factors	Estimated Product Quantity	Estimated Emissions (MMT CO_2e of GHG)
Crude oil (bbl)	0.43 MT CO2/bbl	5,986,000	2.57
Natural gas (mcf)	0.055 MT CO2/mcf	94,024,000	5.17
Total			**7.74**

Source: EPA 2019j

Table 3.14 Historical Oil and Gas Production and GHG Emissions

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

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

Source: BLM 2019

3.3.3 Cumulative Impacts

Cumulative GHG Emissions from BLM NMSO Lease Sales

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

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

In November of 2018, the USGS published a scientific investigation report, Federal Lands Greenhouse Gas Emissions and Sequestration in the United States: Estimates 2005-2014 (Merrill et al. 2018). The 2019 Air Resources Technical Report summarizes this information and separates emissions by mineral and discloses relative percentages relative to national and worldwide GHG emissions. In 2014, end-use combustion and extraction of fossil fuels produced on New Mexico federal lands was 91.63 MMT of CO2e. This value is comparable with the 2014 baseline reported value of 93.72 MMT of CO_2e as reported by Golder Associates (2017). The 2014 baseline for the 13 states evaluated in the Golder Associates report is 1,275.53 MMT of CO_2e, compared with an estimated 1,332 MMT CO_2e in the USGS report (Merrill et al. 2018). The values from USGS and Golder Associates include emissions from the combustion of coal, oil, and natural gas from fossil fuels produced on federal lands as well as extraction emissions from activities occurring on federal lands.

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

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

At the state level, production does not necessarily translate to 100% consumption of the fossil fuel but is representative of future energy consumption and production to show GHG emissions. The development projected in the RFDs for each BLM field office under NMSO jurisdiction (such as the 2018 RFD for the Mancos-Gallup planning area; see Crocker and Glover 2018) are considered in these data. Current and future lease sales are part of each RFD. Because the BLM NMSO has control over lease sales in this area, for NEPA disclosure purposes, this section provides a discussion of reasonably foreseeable cumulative production and consumption within these states and discloses the magnitude of GHG emissions likely to result from BLM NMSO lease sale activities on an annual basis. This information is further contextualized

by comparing the relative magnitude of these emission with projected national and global annual GHG emission rates.

New Mexico Coal, Oil, and Gas GHG Emissions

BLM's New Mexico reasonably foreseeable coal, oil, and gas production and consumption GHG emissions from federal activities are 95.09 MMT of CO_2e/year for the 2020 high scenario and 99.35 MMT of CO_2e/year for the 2030 high scenario (**Table 3.15**). These represent increases of 2.5% and 7.2%, respectively, from the 2014 baseline coal, oil, and gas GHG emissions (92.75 MMT of CO_2e). New Mexico federal coal, oil, and gas GHG emissions of 95.09 (2020 High scenario) and 99.35 (2030 High scenario) MMT CO_2e/year would represent 49% and 52% of state 2020 and 2030 high reasonably foreseeable coal, oil, and gas GHG emissions (see **Table 3.15**).

Oklahoma Coal, Oil, and Gas GHG Emissions

BLM's Oklahoma reasonably foreseeable coal, oil, and gas production and consumption GHG emissions from federal activities are 2.63 MMT of CO_2e for the 2020 high scenario and 2.44 MMT of CO_2e for the 2030 high scenario (see **Table 3.15**). This is a decrease of 1.9% and an increase of 8.9%, respectively, from the 2014 baseline coal, oil, and gas GHG emissions (2.68 MMT of CO_2e). Oklahoma federal coal, oil, and gas GHG emissions of 2.63 MMT (2020 high scenario) and 2.44 (2030 high scenario) MMT CO_2e/year would represent 1.14% and 0.96%, respectively, of state 2020 and 2030 high reasonably foreseeable GHG emissions from coal, oil, and gas activities (see **Table 3.15**).

Kansas Coal, Oil, and Gas GHG Emissions

BLM's Kansas reasonably foreseeable coal, oil, and gas production and consumption GHG emissions from federal activities are 0.42 MMT CO_2e for the 2020 high scenario and 0.47 MMT CO_2e for the 2030 high scenario (see **Table 3.15**). These values represent increases of 5.0% and 17.5%, respectively, compared with the 2014 baseline coal, oil, and gas GHG emissions (0.40 MMT of CO_2e). Kansas federal coal, oil, and gas GHG emissions of 0.42 (2020 High scenario) and 0.47 (2030 High scenario) MMT CO_2e/year would represent 0.97% and 1.01%, respectively, of state 2020 and 2030 high reasonably foreseeable GHG emissions from coal, oil, and gas activities (see **Table 3.15**).

Texas Coal, Oil, and Gas GHG Emissions

BLM's Texas reasonably foreseeable coal, oil, and gas production and consumption GHG emissions from federal activities are 2.50 MMT of CO_2e for the 2020 high scenario and 2.88 MMT of CO_2e for the 2030 high scenario (see **Table 3.15**). These are an increase of 4.2% and 20.7%, respectively, compared with the 2014 baseline coal, oil, and gas GHG emissions (2.40 MMT of CO_2e). Texas federal coal, oil, and gas GHG emissions of 2.50 (2020 high scenario) and 2.88 (2030 high scenario) MMT CO_2e/year would represent 0.18% and 0.19%, respectively, of state 2020 and 2030 high reasonably foreseeable GHG emissions from coal, oil, and gas activities (see **Table 3.15**).

Table 3.15 Reasonably Foreseeable Coal, Oil and Gas Production and Consumption Annual GHG Emissions for BLM New Mexico, Oklahoma, Kansas, and Texas

GHG Emissions (MMT CO_2e/year)					
Category	**New Mexico**	**Oklahoma**	**Kansas**	**Texas**	**NM, OK, KS, TX**
2020 High Scenario					
Federal coal	13.89	1.25	0	0	15.14
Federal oil	25.49	0.33	0.08	0.06	25.95
Federal gas	49.60	0.96	0.29	2.40	53.25
Federal natural gas liquids	6.11	0.09	0.05	0.04	6.29
Total Federal	**95.09**	**2.63**	**0.42**	**2.50**	**100.64**
Federal + non-federal coal	43.12	1.87	0.13	97.46	142.58

Federal + non-federal oil	55.28	56.72	22.10	518.06	652.16
Federal + non-federal gas	83.28	152.16	18.14	694.29	947.87
Federal + non-federal natural gas liquids	12.14	20.09	3.14	84.14	119.51
Total federal and non-federal	**193.82**	**230.84**	**43.51**	**1,393.95**	**1,862.12**
2030 High Scenario					
Federal coal	10.14	0.91	0	0	11.05
Federal oil	25.60	0.33	0.08	0.06	26.07
Federal gas	57.44	1.11	0.34	2.78	61.67
Federal natural gas liquids	6.17	0.09	0.05	0.04	6.35
Total Federal	**99.35**	**2.44**	**0.47**	**2.88**	**105.14**
Federal + non-federal coal	31.52	1.37	0.1	71.12	104.11
Federal + non-federal oil	55.51	56.95	22.19	520.20	654.85
Federal + non-federal gas	96.45	176.21	21.02	804.05	1097.72
Federal + non-federal natural gas liquids	12.25	20.27	3.17	84.88	120.57
Total federal and non-federal	**195.73**	**254.8**	**46.47**	**1,480.25**	**1,977.25**

Note: Sum of individual values may not equal total due to independent rounding.

Source: Golder Associates 2017

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

Cumulative Climate Change Impacts

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

Golder Associates (2017: Section 4.0) discusses future climate projections, including four representative concentration pathways (RCPs) as identified by IPCC: RCP 2.6, 4.5, 6.0, and 8.5. The RCP scenarios were developed based on representative GHG emission scenarios including varying assumptions regarding levels of cumulative global GHG emissions over time. RCP 8.5 assumes increasing GHG emissions over time, with no stabilization, and is meant to be representative of scenarios leading to high GHG concentration levels. RCP 4.5 and RCP 6.0 represent scenarios where GHG emissions are reduced over time through climate policy. RCP 2.6 represents a scenario where drastic action is taken through stringent climate policy and substantial GHG emission reductions are achieved over time. The pathways are named after the radiative forcing (defined as the difference between insolation [sunlight] absorbed by the Earth and energy radiated back to space) projected to occur by 2100 (e.g., RCP 8.5 would be projected to result in 8.5 watts per square meter radiative forcing by 2100). The radiative forcing of the atmosphere in each pathway is driven by the concentration of GHGs accumulated in the atmosphere. The RCP characterizations and regions are further described by Golder Associates (2017: Section 4.1) Climate Change report.

Climate change is driven by radiative forcing, which is influenced by cumulative GHG emissions, not annual emission rates from any given sub-national project. Figure **3-1** shows a comparison of global cumulative emissions in relation to RCPs 2.6, 4.5, and 8.5, representing low, medium, and high global cumulative emissions scenarios.

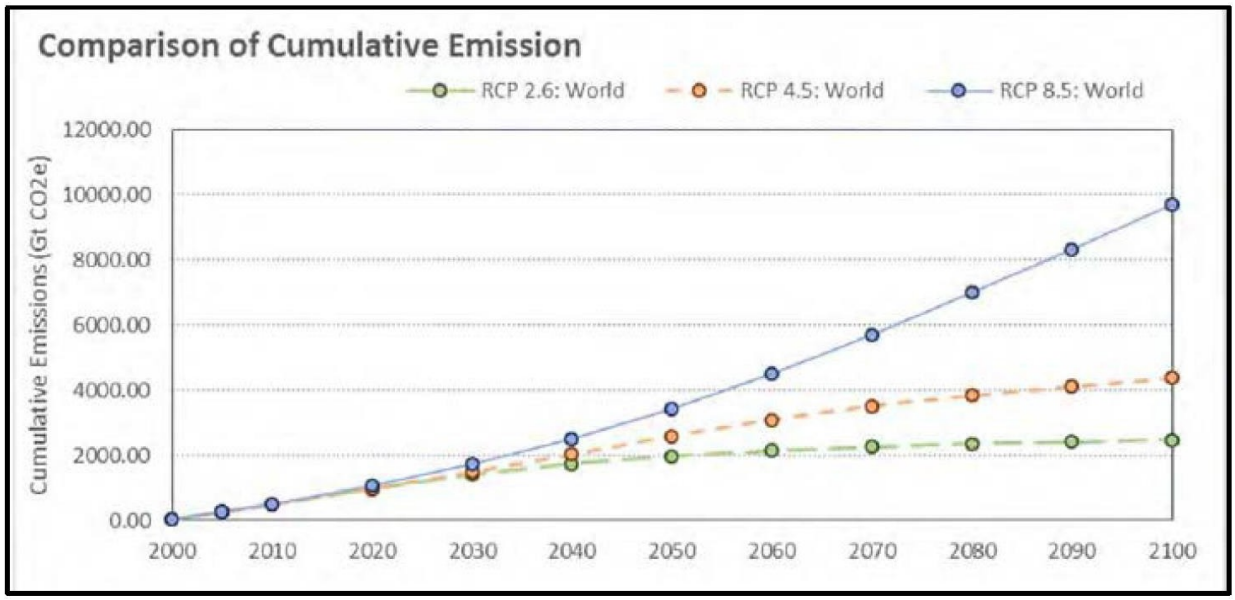


Figure 3-1. Comparison of RCP 2.6, RCP 4.5, and RCP 8.5 cumulative emission estimates over the twenty-first century

When considering the cumulative emissions on a global scale, the annual emission rates of various sub-national projects are one of many emission contributions. Any single contribution on a sub-national scale is dwarfed by the large number of comparable national and sub-national contributors on a global scale.

However, the best surrogate for understanding the potential impact of BLM's sub-national scale emissions on climate is estimating projected annual emission rate due to BLM energy lease sale projects. Golder Associates (2017) provides projections of GHG emissions from the 13 western states that regulate most of the federal fossil fuel leasing and compares these emissions with GHG emissions from other contributors. To accomplish this comparison, the Golder Associates demonstrates a comparison of the projected BLM annual emission rates derived from federal lease sale and production information from the 13 western states and compares them against the RCP scenario emissions profile (a derived value estimating the annual GHG emission rate for each scenario). This comparison is provided in **Figure 3-2.**

For additional context, 2014 baseline year federal resource production and consumption estimates for these13 states can be compared with the 2014 baseline national energy consumption and total GHG emissions.BLM subnational emissions in these 13 states were approximately 25.97% of the total national energy consumption and 19.75% of national GHG emission totals at 2014 levels. In 2014, federal mineral production and consumption in these 13 states represented approximately 2.64% of the global totals from all emission sources. With the relative magnitude of these emissions in mind, climate change trends and impacts are discussed below.

The contribution of GHG emissions from coal, oil, natural gas, and liquefied natural gas for the 13 BLM subject states in 2020 and 2030 under both normal and high production scenarios were evaluated and compared with the GHG emissions profile (the derived annual emission rate for the three RCP scenarios shown in **Figure 3-2**). By comparing the relative emission rates of the derived ranges of BLM emissions profiles (low and high estimates) with the RCP scenarios, the BLM emissions most closely track with RCP 8.5 in 2020 and between RCP 2.6 and RCP 4.5 in 2030 (Golder Associates 2017). The reduction in BLM's emissions profile in 2030 compared with 2020 is a result of a projected change to the federal energy

resource mixture. Less coal development is projected, while a slight increase in oil, gas, and natural gas liquids are projected into 2030 relative to 2020. Because coal is the most GHG-intensive fossil fuel, the reduction in this resource development is anticipated to reduce BLM's lease sale emissions profile (annual GHG emission rate) overall (see **Figure 3-2**).

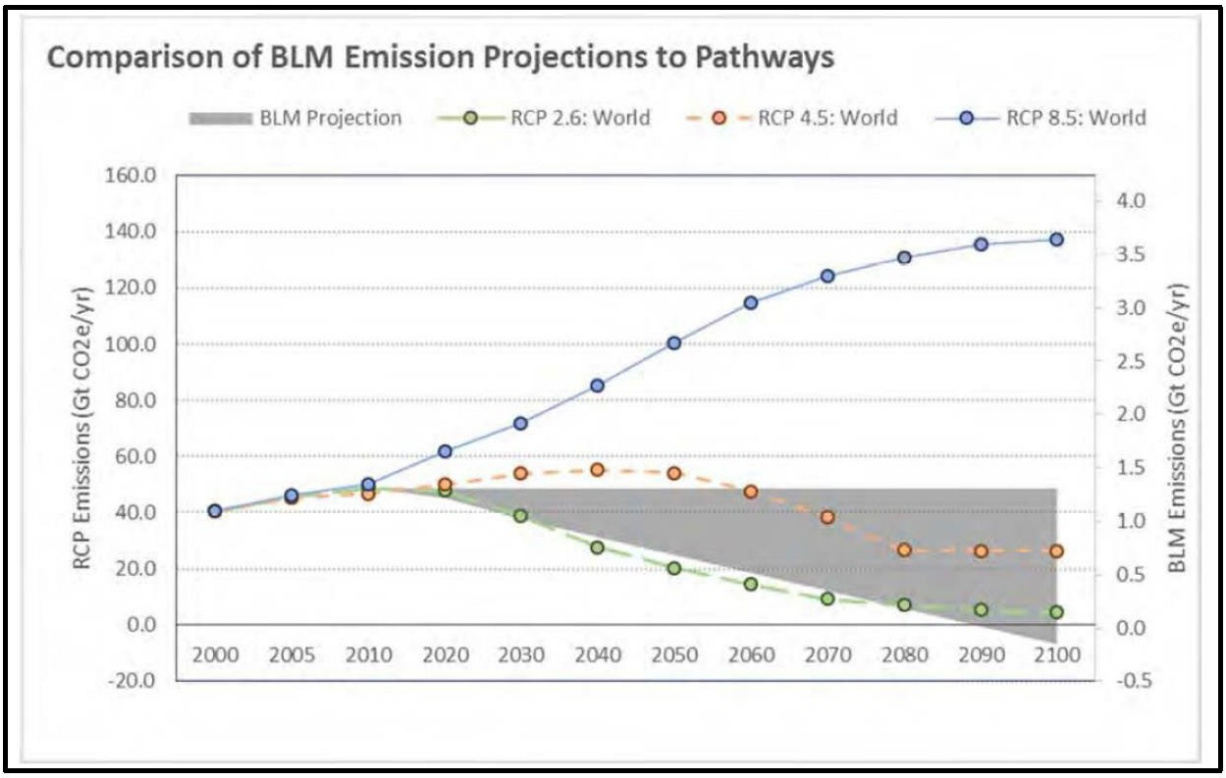


Figure 3-2. Comparison of BLM Emission Projections with RCP 2.6, RCP 4.5, and RCP 8.5

Based on the analysis in Golder Associates (2017), BLM activities are estimated to be conducted at a level that would be in line with the level of emissions anticipated in the RCP 2.6 and RCP 4.5 through 2060. Estimates of BLM activities in future years are more uncertain and have a wider range of variability. The projections presented above are based on best available data and assumptions used to provide context to BLM's cumulative impact. However, due to the levels of uncertainty, some additional information is provided below regarding BLM's relative contribution to global emissions and, by proxy, climate change. If BLM operates under the business-as-usual scenario while all other contributors are reducing their emissions in line with RCP 2.6, the relative contribution of BLM increases as the emissions more closely resemble RCP 4.5. If BLM operates under the decreased emissions scenario, keeping their reductions in line with RCP 2.6 like all the other contributors, the relative contribution of BLM remains similar to current contributions. If BLM operates under the decreased emissions scenario while all other contributors are maintaining constant emissions (business-as-usual) or increasing emissions, the relative contribution of BLM greatly reduces. It is very unlikely that the global cumulative emissions will be strongly influenced by a single contributor at a national or sub-national scale. However, the individual behavior of each contributor, through their relative contribution, has the ability to influence which RCP global emissions scenario is most closely resembled and, therefore, which climate change projections are most likely manifested toward the end of the century (Golder Associates 2017).

To understand the impacts of climate change, the various RCP scenario projections of global temperature and precipitation changes under three RCPs in both the near term (representing the period from 2021 through 2040) and far term (representing the period of 2081 through 2100) are presented below in **Table 3.16**. These estimates are derived from the average of over 30 different climate change models using the inputs of each RCP scenario.

Table 3.16 Projected Changes in Climate under Representative Concentration Pathways

RCP Pathway	Near Term		Far Term	
	Temperature (°C)	Precipitation (%)	Temperature (°C)	Precipitation (%)
RCP 2.6	0.78	1.44	0.97	2.27
RCP 4.5	0.85	1.49	1.81	3.51
RCP 8.5	0.96	1.62	3.68	5.89

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

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

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

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

3.3.4 Mitigation Measures and Residual Effects

The BLM best management practices are designed to reduce impacts on air quality (see Issue 1) and reduce methane and GHG emissions with FIMO's concurrence. BLM's BMPs would be applied at the site specific APD NEPA process. During that process FIMO may or may not concur with the analyses including BMPs and COAs. If FIMO does not concur with any portion of the analyses the BLM would have the opportunity to modify the analyses to gain concurrence. In addition, the BLM encourages industry to participate in the Natural Gas STAR program that is administered by the EPA. The Natural Gas STAR program is a flexible, voluntary partnership that encourages oil and natural gas companies to adopt proven, cost-effective technologies and practices that improve operational efficiency and reduce natural gas emissions (EPA 2006). Adoption of the Natural Gas STAR program would likely significantly reduce CO2e emissions since the program is particularly focused on reducing methane, which has a high GWP. However, adoption of Natural Gas STAR Program best practices would reduce but not eliminate GHG emissions.

VOC control measures from oil and gas–related non-point sources include reducing emissions at storage tanks, use of flares, and a leak detection and repair program to capture fugitive emissions (leaks). The EPA has New Source Performance Standards (NSPS) in place, NSPS OOOO, to reduce VOCs from well completion operations and storage tanks constructed after August 23, 2011 (EPA 2017b). NSPS OOOOa requires reduction of VOCs from well completion operations and storage tanks and imposes semiannual monitoring requirements for the collection of fugitive emission components at well sites constructed after September 18, 2015. Following the 2020 amendment to OOOO and OOOOa, fugitive emissions monitoring is only required for those wells producing greater than 15 bbl per day. Other emission controls of VOCs include vapor recovery units, enclosed combustors (vapor combustion unit), and open-tipped (candlestick flares). The most desirable control method is a vapor recovery unit since this recovers the natural gas production and sends the gas to the sales line or back to the process for facility use. Finally flaring helps to reduce 98% of VOC emissions at petroleum flares (EPA 2017b).

3.4 Water Use and Quantity

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

The following analysis summarizes information contained in the *2020 BLM New Mexico Water Support Document*, hereafter referred to as the Water Support Document (BLM 2020a). This analysis is also supported by the Mancos-Gallup RFD Scenario (Crocker and Glover 2018). The analysis area established to analyze impacts on water quantity is the New Mexico portion of the San Juan Basin (San Juan, McKinley, Rio Arriba, and Sandoval Counties), which is the likely location of water sources used to support future potential development of the lease parcels. Most of the water use for oil and gas development in the New Mexico portion of the San Juan Basin is sourced from groundwater.

3.4.1 Affected Environment

Current Total Water Use in the Analysis Area

The Water Support Document relies on the 2015 USGS report, *Estimated Use of Water in the United States in 2015* (Dieter et al. 2018), to characterize total water withdrawals across eight water use categories: aquaculture, domestic, industrial, irrigation, livestock, mining, public water supply, and thermoelectric power.

Water use for 2015 in the San Juan Basin is summarized in **Table 3.17**. Within the San Juan Basin (which encompasses San Juan, McKinley, Rio Arriba, and Sandoval Counties), total water use in 2015 was estimated at 486,604 acre-feet (AF). About 10% of this total (or 50,008 AF) came from groundwater. Two percent (11,659 AF per year) of total water use in the San Juan Basin is attributable to mining (the category which oil and gas operations are reported), all of which comes from groundwater. The largest water use categories in the San Juan Basin are irrigation (79%), followed by public water supply (8%).

Table 3.17 Water Use by Category in 2015 within the Farmington Field Office (San Juan, Rio Arriba, McKinley, and Sandoval Counties)

Category	Surface Water			Ground Water		Total With-drawals	Total Use				
	Fresh (AF)	Saline (AF)	Total (AF)	Fresh (AF)	Saline (AF)	Total (AF)	Fresh (AF)	Saline (AF)	Total (AF)	Total (AF)	% Total Use
Aquaculture	0	0	0	4,641	0	4,641	4,641	1%	0	4,641	1%
Domestic	0	0	0	8,979	0	8,979	8,979	2%	0	8,979	2%
Industrial	0	0	0	2,634	0	2,634	2,634	0.5%	0	2,634	0.5%
Irrigation	381,241	0	381,241	3,576	0	3,576	384,817	79%	0	384,817	79%
Livestock	437	0	437	987	0	987	1,424	0.3%	0	1,424	0.3%
Mining	02,724	0	2,724	3,677	5,258	8,935	6,401	1%	5,258	11,659	2%

Public Water Supply	21,596	0	21,596	17,958	0	17,958	39,554	8%	0	39,554	8%
Thermoelectric Power	30,637	0	60,637	2,298	0	2,298	32,935	7%	0	32,935	7%
Total	436,635	0	436,635	44,750	5,258	50,008	481,346	98.9%	5,258	486,604	100%

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

Note: See the Water Support Document (BLM 2020a) for graphical representation of these data, as well as comparisons with water use across the state of New Mexico.

Current Water use associated with oil and gas development

As part of oil and gas development, water is used for drilling fluid preparation and make-up water for completion fluids, in well stimulation (of which the most common method is hydraulic fracturing), as rig wash water, as coolant for internal combustion engines, for dust suppression on roads or well pads, and equipment testing. The majority of water used for oil and gas development in the New Mexico portion of the San Juan Basin is sourced from groundwater; however, roughly 23% (2,724 AF) of mining water was sourced from surface water.

Water use associated with stimulation activities (including hydraulic fracturing), which comprises the majority of water use, is dependent on many factors, including the geologic formation. On average, the water use associated with hydraulic fracturing for vertical wells in the New Mexico portion of the San Juan Basin is 0.537 AF/well (BLM 2020a). Horizontal wells require more water than vertical wells. The 2018 Reasonable Foreseeable Development (RFD) Scenario for oil and gas activities in the FFO (Mancos-Gallup RFD) reported that horizontal wells in the San Juan Basin require on average approximately 3.13 AF of water per well completion (Crocker and Glover 2018). More recent information on horizontal well development in the San Juan Basin has indicated water use is slightly higher. Because of this uncertainty, the Water Support Document analyzed data from FracFocus, a national hydraulic fracturing chemical registry managed by the Ground Water Protection Council and Interstate Oil and Gas Compact Commission, to provide objective information on hydraulic fracturing (BLM 2020a). Operators are required by the State of New Mexico to disclose chemistry and water use information on FracFocus. Analysis of 2018 FracFocus data for the New Mexico portion of the San Juan Basin resulted in a value of 4.84 AF of water per horizontal well completion (BLM 2020a). Average water use decreased in 2019 to 1.8 AF/well, this number is so much lower than previous years due to a large quantity of recompletion activities that occurred in 2019 and a decrease in new horizontal completions. The 2019 new well completion average was 8 AF (this is an average of the nitrogen completions as well as the slick water completions, these are the new well completion averages), nitrogen completion average was 5.6 AF, slick water completions 49.2 AF and recompletion average was 0.23 AF (FracFocus 2019).

Fluid mineral development in the San Juan Basin has experienced technological advances with the introduction of slick water stimulation beginning in 2015. The FFO has used 20 wells that have been drilled using long laterals with slick-water stimulation within the FFO to establish average water use. According to data from FracFocus, the average water use associated with slick water stimulation of the 20 wells is 41 AF (BLM 2020a). Using this information, and an average lateral well bore of 1.5 miles (as obtained from well completion reports), the BLM has calculated an average of 27 AF per lateral mile. The Water Support Document (BLM 2020a) contains additional background information on slick water fracturing in the FFO as well as information regarding the methodology for capturing information and calculating water use by stage.

Annual water use by oil and gas wells throughout New Mexico increased more than eight-fold, from 4,060 to 34,992 AF, between 2014 and 2019, with a corresponding increase in average water use from 6.0 to 36.8 AF/well ([BLM 2020a]; **Table 3.18**). The six-year average (2014-2019) water use is 23.6 AF/well. The proportion of federal to non-federal wells varies within a year and ranged from 13.4% to 47.7%. From 2014 to 2019, cumulative water use within New Mexico totaled 100,721 AF with federal wells comprising 26.8% (27,086 AF). From 2014 to 2019, 4,264 total wells (includes all ownership/management jurisdictions) were reported as completed with an average of 710 wells/year (BLM 2020a).

Table 3.18 Water Use by Oil and Gas Wells in New Mexico from 2014–2019

Year	Federal Water Use (AF)	Non-Federal Water Use (AF)	Total Water Use (AF)	Federal Water Use (%)	Average Water Use per Well (AF)	Total Number of Wells Reported
2014	1,468	2,592	4,060	36.2	6.0	681
2015	4,083	4,475	8,558	47.7	14.4	596
2016	920	5,958	6,878	13.4	20.3	339
2017	3,385	11,128	14,513	23.3	24.5	593
2018	9,292	22,429	31,721	29.3	28.5	1,114
2019	7,939	27,055	34,994	22.7	36.8	950
Total	**27,086**	**73,635**	**100,723**	**—**	**23.6**	**4,264**

Source: BLM 2020a

Notes: Data are only presented for wells which report water use data.

Potential Water Sources

Most water used in mining activities (which encompasses oil and gas development) in the counties within the FFO is currently from groundwater (BLM 2020a). Groundwater is a more readily available source of water than surface water due to the ephemeral nature of many surface water features in the San Juan Basin. Generally, sources of groundwater can be found in nearly every area of the FFO. Water yields in these areas vary, but most aquifers yield less than 20 gallons per minute (BLM 2020a). Aquifers that are known to yield sufficient quantities of water are usually found within the sandstone units of Jurassic, Cretaceous, and Tertiary age (BLM 2020a). Aquifers that have the potential to yield 100 gallons per minute include the Ojo Alamo Sandstone, the Nacimiento Formation, and the San Jose Formation, all of which are within the greater Uinta-Animas aquifer (BLM 2020a).

San Juan Basin oil and gas operators have included plans to use multiple hydraulic fracturing methods including slick water fracturing technology. The two general water types that may be used for slick-water stimulation are categorized as “potable/fresh” and “non-potable”. Any water that has total dissolved solids (TDS) greater than 1,000 ppm has been defined as “non-potable” by the State of New Mexico (72-12-25 NMSA 1978), the BLM has identified anything less than 10,000 ppm to be protected in the casing rule of the BLM’s Onshore Order #2 (BLM 1988). Non-potable water is outside the appropriative processes and is mainly diverted for mineral exploration purpose. The higher allowable TDS levels expand the possible water sources beyond those that are traditionally used (e.g., surface or ground water) into non-traditional sources of water (e.g., non-potable groundwater sources). Recently, the NMOSE has approved permits to drill wells within the San Juan Basin to withdraw non-potable connate water (groundwater) from the Entrada sandstone formation for use as a potential source of water. Water contained in the Entrada formation is highly saline (Kelley et al. 2014). As such, it is considered non-potable and has not been declared as an administrative aquifer by the NMOSE. The NMSOE is the agency responsible for water withdrawal permitting actions.

Other sources of non-potable water that can be utilized in stimulation are “flowback fluid” and “produced water”. Flowback fluid is a mixture of water and small amounts of chemicals and other proppants that flow back through the well head directly after stimulation activities. Generally, 10-40% of the initial volume utilized for stimulation activities returns as flowback fluid, of this 10-40% is non-potable water that may be used in future stimulation activities. Produced water is naturally occurring water that exists in the formation that is being targeted for mineral extraction and is produced as a byproduct, therefore becoming “produced water”. Based on operator input, after the initial flowback recovery of 10-40%, remaining water used for stimulation does return to the surface through production activities at a slower rate of return. The Water Support Document (BLM 2020a) contains additional information for potential water sources that may be used.

3.4.2 Environmental Impacts

Future potential development on the lease parcels is estimated at approximately forty-nine horizontal wells and two vertical wells (see **Table 2.1** for a listing of the number and type of wells anticipated per parcel). This analysis assumes that all parcels would be developed concurrently. This assumption facilitates quantification in the analysis and provides a conservative (high) estimate of maximum water use as a result of leasing and future potential development of the lease parcels.

Drilling and completion of forty-nine horizontal wells and two vertical wells in the lease parcels is estimated to use approximately 238.23AF of groundwater. This calculation is based on a factor of 4.84 AF per horizontal well and 0.537 AF per vertical well (see Section 3.4.1, and BLM 2020a). Note that if the more water-intensive stimulation methods (e.g., slick water fracturing) are implemented or if laterals become longer, water use could increase from these estimates. Alternatively, water use estimates could be lower if produced water is reused or recycled for use in hydraulic fracturing. Produced water associated with development of the lease parcels is estimated at approximately 4,818,000 barrels (see Chapter 2). Produced water would be disposed of at regulated and permitted commercial facilities (such as saltwater disposal wells) or could be used in the drilling and completion of wells.

The projected future potential development of forty-nine horizontal wells and two vertical wells in the lease parcels would result in less than 0.05% of the 2015 San Juan Basin total water use (486,604 AF; see **Table 3.17**), 0.5% of 2015 San Juan Basin total groundwater use (50,008 AF; see **Table 3.17**) and would result in a 2% increase over 2015 water use in the mining category for the San Juan Basin (11,659 AF; see **Table 3.17**). The total estimated water use for drilling and completion of forty-nine horizontal wells and two vertical wells (238.23 AF) in a single year represents approximately 0.7% of the 2019 San Juan Basin oil and gas water use (34,994 AF; see **Table 3.18**). The percent contribution to annual water use would be lower if well development is spread out over a period of years.

Water used for the purpose of oil and gas drilling and completion may be purchased legally from privately held water rights in or around the San Juan Basin. The transaction would be handled by the NMOCD, as well as the NMOSE (see NMOSE 2017). All water uses would be evaluated at the time of proposed lease development in site-specific NEPA analysis and subject to standard lease terms and conditions. As noted in Section 3.4.1, recently, the NMOSE has approved permits to drill wells within the San Juan Basin to withdraw non-potable connate water (groundwater) from the non-potable Entrada sandstone formation for use as a potential source of water for hydraulic fracturing operations. **Table 4.10** of the Water Support Document (BLM 2020a) identifies additional potential sources of groundwater in the analysis area.

3.4.3 Cumulative Impacts

Past and Present Actions - Past and present water use is summarized in 3.4.1, Affected Environment. Total water use in the counties of New Mexico comprising the San Juan Basin (486,604 AF) accounted for 15% of all 2015 state withdrawals; mining (which includes oil and gas development) comprised about 2% of 2015 San Juan Basin water withdrawals. The largest water use category within the analysis area and within the state of New Mexico is agricultural irrigation, comprising 79% of all water use within the San Juan Basin and 82% of all water use within the state.

Reasonably Foreseeable Future Actions - The Mancos-Gallup RFD Scenario (Crocker and Glover 2018) projects approximately 160 new wells per year, for a total of 3,200 wells over a 20-year period. Of this total, 2,300 wells would be horizontal, and 900 wells would be vertical. With consideration of the revised water use estimates discussed in the Water Support Document (4.84 AF per horizonal well and 0.537 per vertical well), development of the RFD scenario would require 11,615 AF water for the entire 3,200 well/20-year scenario, or approximately 580 AF of water in any given year (BLM 2020a). Note that this includes both federal and non-federal wells. Well development projected as a result of ongoing BLM and state lease sales and lease reinstatements is already considered in the RFD scenario. Well development associated with recent or reasonably foreseeable APDs or master development plans are also included in the RFD scenario. See the Water Support Document (BLM 2020a) for more information about the RFD scenario and water use estimates.

Beginning in 2015, the FFO began receiving APDs that included new technologies that utilize greater quantities of water during the stimulation of the well under development, such a slick water stimulation. If operators implement slick water stimulation more frequently than occurred in 2018 and prior years, it is expected that total water use volumes on a per well basis would trend upward. To address this concern, the BLM developed new water use estimates for development of the horizontal portion of the RFD (2,300 horizontal wells) using slick water stimulation techniques. See the Water Support Document (BLM 2020a) for more information about the slick water use estimates. Using an average of a 2-mile lateral for each horizontal well, the BLM estimates that development of 2,300 horizontal wells in the Mancos Shale and Gallup Sandstone formations via slick water and 900 vertical wells is estimated to be approximately 125,000 AF, or 6,250 AF in any given year.

No other RFFAs with substantial use have been identified. There are no reasonably foreseeable mining projects that would contribute to cumulative water withdrawals within the San Juan Basin. Some water use would be required during construction and operations of reasonably foreseeable transmission lines and pipelines; these uses are addressed in the Water Support Document (BLM 2020a). Future water use for the other reported water use categories in the San Juan Basin is assumed to continue at current levels, and agricultural irrigation would continue to be the highest water use category in the San Juan Basin.

Cumulative Water Use - Development of the Mancos-Gallup RFD Scenario using water use values of 0.537 AF/vertical well (Crocker and Glover 2018), and 4.84 AF/horizontal well (BLM 2020a) would result in the use of approximately 11,615 AF of water, or 580 AF of water in any given year (**Table 3.19**). This water use would occur over approximately 20 years and would cumulatively represent about 0.12% of San Juan Basin 2015 total water withdrawals. As noted above, irrigation for agriculture would remain by far the largest water use within the New Mexico portion of the San Juan Basin (currently 79% of all water use within that area).

Table 3.19 Cumulative Water Use Projections

Well Orientation	2018 Mancos-Gallup RFD	Slick Water Trend Projections	Quantity Increase
900 verticals	483 AF	483 AF	0 AF
2,300 horizontals	11,132 AF	124,515 AF	113,866 AF
3,200 Wells Total	**11,615 AF**	**124,998 AF**	**113,866 AF**

Source: BLM 2020a

If the slick water trends noted above are realized and remain consistent over the 20-year development scenario time frame, total cumulative water volumes would be closer to the totals disclosed in **Table 3.19** (approximately 125,000 AF, or 6,250 AF in any given year), assuming 53 AF/well (BLM 2020a). This water use would occur over approximately 20 years and would cumulatively represent about 1.3% of San Juan Basin 2015 total water withdrawals (486,604 AF). The Slick Water Trend projection was developed as a maximum reasonable estimate of future water use if existing slick water stimulation techniques (which currently comprise 3 percent of all well completions in the San Juan Basin) were to be applied to all 2,300 horizontal wells forecasted in the RFD over the next 20 years versus the use of less water-intensive stimulation technologies, such as nitrogen completions. Note that water associated with the 2019 trend projections may come from non-traditional water sources, including the connate water within the Entrada formation, recycled flowback water, and produced water. These water sources are options that cannot be used for other water uses described in **Table 3.17**, such as irrigated agriculture (which would remain by far the largest water use within the San Juan Basin). Annual water use associated with future potential development of the proposed lease parcels (forty-nine horizontal wells and two vertical wells resulting in 238.23 AF, assuming all wells are developed in the same year) would comprise about 2% of total RFD water projections and 0.2% of total Slick Water Trend projections. This translates to 41% of annual RFD projections (580 AF per year) and 4% of annual Slick Water Trend projections (6,250 AF per year).

3.4.4 Mitigation Measures and Residual Effects

Public concern about water use from hydraulic fracturing is especially high in semiarid regions, where water withdrawals for hydraulic fracturing can account for a significant portion of consumptive water use within a

given region. Overall, there have been calls to increase the use of alternative water sources such as brackish water or recycling produced water, minimizing the strain on local freshwater resources (Kondash et al. 2018). Recent studies indicate that the water used for hydraulic fracturing may be retained within the shale formation, with only a small fraction of the fresh water injected into the ground returning as flowback water; water returning to the surface is highly saline, is difficult to treat, and is often disposed through deep-injection wells (Kondash et al. 2018). Thus, the ability to recycle water may be more limited than previously reported. As noted above, hydraulic fracturing can be accomplished using non-traditional water sources, including connate water, and recycled flowback water. The BLM encourages the use of recycled water in hydraulic fracturing techniques and works with operators during their planning phases to collocate facilities for the management of water including extraction, reuse, treatment, storage, and disposal of water during the life cycle of lease development.

3.5 Cultural Resources

3.5.1 Affected Environment

As a result of a proposed federal leasing action, Section 106 of the National Historic Preservation Act requires federal agencies to consider what effect their licensing, permitting, or otherwise authorizing of an undertaking, such as mineral leasing, may have on properties eligible for the National Register. Below are additional cultural resource legislations that must be considered in evaluating the impacts of the federal undertaking. These govern the protection, access, and use of scared sites, sacred items, protection, and treatment of human remains, and the protection of archaeological resources ascribed with cultural or historic importance. These include the following:

- The American Indian Religious Freedom Act of 1978 (AIRFA; 42 USC 1996, P.L. 95-431 Stat. 469). Possession of sacred items, performance of ceremonies, access to sites.
- Executive Order (EO) 13007 (24 May 1996). Access and use of sacred sites, integrity of sacred sites.
- The Native American Graves Protection and Repatriation Act of 1990 (NAGPRA; 25 USC 3001, P.L. 101-601). Protection, ownership, and disposition of human remains, associated funerary objects, unassociated funerary objects, sacred objects, or objects of cultural patrimony.
- The Archaeological Resources Protection Act of 1979 (ARPA; 16 USC 470, Public Law 96-95). Protection or archaeological resources on Federal and Indian lands.

In addition to federal legislation, FIMO must also consider Navajo Nation cultural resource protection laws and policies for Navajo Allotments. These include the following:

- Navajo Nation Cultural Resource Protection Act (CMA-19-88/NNCRPA),
- Navajo Nation Policy for the Protection of Jishcháá; Gravesites, Human Remains, and Funerary Items,
- Navajo Nation Policy to Protect Traditional Cultural Properties (TCP),
- Navajo Nation Disposition of Cultural Resource Collections Policy.

Native American Cultural & Religious Concerns

Major issues and concerns of Native Americans who have cultural ties to the San Juan Basin include but are not limited to cultural resources such as archaeological sites, landscapes, traditional cultural properties (TCP; Parker and King 1998) or places. For this purpose, archaeological sites are identified by pedestrian surveys; however, TCPs need additional cultural inventory methods to identify them.

TCP is a term that has emerged in historic preservation management and the consideration of Native American traditional concerns. TCPs are places that are eligible for the National Register of Historic Places and have cultural values, often sacred, that transcend the values of scientific importance that are normally ascribed to cultural resources such as archaeological sites and may or may not coincide with archaeological sites. Native American communities are most likely to identify TCPs, although TCPs are not restricted to those associations.

In general, TCPs can only be identified in most cases in a two-step process which include a pedestrian cultural inventory survey(s) and ethnographic interview(s). Furthermore, most Native American TCPs are considered to involve esoteric knowledge which is considered confidential to specific Native American Tribes, groups, and individuals. Some TCPs are well known, while others may only be known to a small group of traditional practitioners, or otherwise only vaguely known.

Native American perspectives on what is considered a TCP are not limited by the definition of the National Register eligibility or lack thereof. For this reason, the BIA and FIMO often employ more generic and inclusive terminology.

A review of relevant cultural resource data sets was undertaken to understand the effects of leasing on known cultural resources and is presented in Appendix C. Data sets include the New Mexico Archaeological Records Management System (ARMS), TCP data on file with the NNHHPD and BLM, Government Land Office (GLO) records, and various Navajo, State, and National Registers of Historic Places.

As seen in **Table 3.20** there are 340 previously recorded archaeological sites present within the proposed lease sale allotments and the associated Area of Potential Effect (APE). Of these, 148 (44%) have been determined or can reasonably be assumed to be eligible for the National Register (18 Criteria A, C & D; 130 Criterion D), 29 (8%) have been determined not eligible, and the remaining 163 (48%) have not had a determination made.

Where development occurs in proximity to sites sensitive to indirect impacts, special BMPs or mitigations formulated through consultation between the BIA and affected tribes and/or individual traditional religious practitioners may be necessary to reduce visual contrast or other indirect impacts and achieve no effect or no adverse effect to important cultural resources. True determinations of effect and any necessary mitigation would be developed during future, site-specific analyses for individual development projects; however, the lease does include a stipulation that mandates consultation with the Navajo Nation Historic Preservation Office (THPO).

Table 3.20 NRHP Determinations with Assumed Eligibility

	Number of Cultural Resources	Eligible (Criteria)	Not Eligible	Undetermined	Unknown	NR Listed
Physical Effects APE	58	11 (A, C, D) 18 (D)	3	12	14	0
Audio-Visual Effects APE	282	7 (A, C, D) 112 (D)	26	45	92	4

Table 3.21 TCP Summary

Effects APE	Number TCPs Present	Parcel Number
Only Physical	0	NA
Only Audio-Visual	42	6, 10, 11, 16, 116, 117, 118, 120, 121, 122, 128, 131, 220, 259, 211478
Physical & AV	10	107, 119, 172, 219, 223, 224, 226, 228, 229, 236, 237, 260, 261, 263, 264, 265, 260245, M259

3.5.2 Impacts from the Proposed Action

Direct and Indirect Impacts

While the act of leasing a parcel would produce no impacts, reasonably foreseeable subsequent development of the lease as an indirect impact of the leasing action could have effects on cultural resources. As described, the extent of oil and gas development is likely to amount to the construction and operation of one well pad per Allotment parcel, with associated access road and ancillary equipment. Total disturbance would likely be approximately 6.85 acres or 4.2% of each Allotment.

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 and most often include

alterations to the physical integrity of a cultural resource. The greatest potential impact to cultural resources stems from the construction of lease related facilities such as pipelines, power lines, roads, and well locations, as well as an 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 activities could affect one or more aspects of a historic properties' physical integrity including location, design, materials, and workmanship. 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 one or more of the historic properties' aspects of integrity including setting, feeling, and association, if those aspects of integrity contribute to conveying the significance of the historic property.

Due to the confidential nature of the information provided by the NNHHPD, it is difficult known to what extent the reasonably foreseeable outcome of leasing (i.e., energy development) would physically threaten the integrity of previously recorded historic properties and TCPs, prevent access to sacred sites, prevent the possession of sacred objects, or otherwise interfere with the performance of traditional ceremonies and rituals. Based on the review of best available data (**Appendix C**) the undertaking is determined to have no adverse effects to historic properties. In addition, NNHHPD has not recommended that any of the Allotment parcels be pre-emptively withdrawn from leasing.

Use of lease notices and stipulations, and Native American consultation (including Navajo Nation Chapters) is recommended to ensure that new information is incorporated and taken into account during site-specific level analysis and authorizations. Once a project-specific development proposal is submitted, areas of potential effects (APE) will be identified, and a Class I literature search and Class III archaeological/ethnographic survey will be conducted according to NNHHPD policy. The outcome of project-specific consultation and APE surveys would be used to develop project-specific changes or mitigation measures.

Mitigation Measures

All leases would also contain lease stipulations BIA-4 and 11 (**Appendix A**), which mandate consultation with the THPO. Additional measures to minimize impacts to cultural resources would be developed upon the submittal of development permits to the BLM, as identified in the NEPA process and carried forward into COAs attached to the permit. Standard BLM COAs that address the discovery of previously unknown cultural resources would also be included in the permit.

3.6 Grazing and Rangeland Resources

The Proposed Action occurs within seven (7) grazing allotments, listed in **Table 3.21** below. Range improvements such as earthen reservoirs, fences, and brush control projects are located throughout these seven grazing allotments; however, the Proposed Action does not include any acreage within the grazing allotments that contain identified range improvements. Two parcels (#219 & #220) are located within the Highway 57 allotment, and there are earthen water retaining structures in proximity to these parcels but not within them.

Table 3.21 Range Allotments and Resources in Project Area

Grazing Allotment Name	Total Grazing Allotment Area (acres)	Lease Portion in Project Area (acres & %)	Grazing Infrastructure in Immediate Vicinity
Blanco Navajo Community (NM05078)	10,200	160 / 1.6%	None
Counselor Community (NM06015)	100,750	320 / 0.3%	None
Escavada AMP (NM00614)	19,250	160 / 0.8%	None
Highway 57 (NM27658)	29,800	320 / 1.1%	1 earthen dam, 1 stock pond
Kimbeto Community	103,500	4,462.04 / 4.3%	None

(NM06013)			
Largo Community (NM05083)	47,050	320 / 0.7%	None
Otis Community (NM06011)	31,800	320 / 1.0%	None
Totals	**342,350 acres**	**6,242.04 acres / 1.8%**	

3.6.1 Impacts from the Proposed Action

Direct and Indirect Impacts

There would be no direct impacts to the currently existing grazing and rangeland use of any of the parcels included in the Proposed Action. The leasing action is solely an administrative process and subsequent NEPA analysis and permit approval would be required for future oil and gas development and production activities that may occur as a result of the leasing action.

Indirect impacts include the reasonably foreseeable energy development that is likely to occur on the parcels as a result of the leasing action. Past and current use on these parcels includes grazing and range management activities. It is assumed that these grazing activities would continue to occur, regardless of the density of oil and gas development, since divided interests in the grazing allotment land surface and associated range permits are often held by different surface owners than those holding mineral rights.

Foreseeable development consists of one to two wells per parcel depending on hydrocarbon potential (**Table 2.2** and **Table 2.3**). The well(s) would be co-located on a single well pad and would also include the construction of an access road to the well pad. The total level of disturbance associated with this development is estimated at 6.85 acres, or 4.2% of each parcel. This acreage would be disturbed as described in **Appendix B**, and any available forage would be lost. Some portion of the disturbance would be reclaimed and revegetated, but the road and well pad working surface would represent a permanent loss of grazing area for the productive life of the well(s).

Mitigation Measures

All parcels included in a grazing allotment (except parcel 235) would have lease stipulation BIA-3 attached to the lease. BIA-3 requires the grazing rights to the surface shall be protected, that any use of water shall be unimpaired, and compensation will be required for all surface damages, including the surface disturbance associated with the reasonably foreseeable level for development.

3.7 Hydrologic Resources

3.7.1 Affected Environment

The Project is located over the mapped Uinta-Animas aquifer of the larger Colorado Plateaus aquifer system. The aquifer formations consist of permeable Tertiary sandstones interlayered with relatively impermeable shales and mudstones. In the vicinity of the Proposed Action, depth to the Uinta-Animas aquifer is approximately 200 feet below surface. There are no mapped surficial aquifers in the alluvial/colluvial layers near the surface (USGS 1996). There are minimal areas of groundwater discharge in the vicinity of the Proposed Action: the valley of the San Juan River is the principal area of groundwater discharge in the San Juan basin.

Surface water within the Proposed Actions is limited to ephemeral washes. The principal surface drainage features within the Proposed Action area are Kimbeto Wash, Blanco Wash, and Escavada Wash. Twelve (12) of the parcels included in the Proposed Action include surface areas that are within the channels of these large washes. All parcels are tributary to the Chaco River and thence to the San Juan River, with the exception of parcels 211425, 211452M, and 211478, which are tributary to the San Juan River via Blanco Wash. The area was evaluated for potential jurisdictional wetlands and other Waters of the U.S. All parcels within the Proposed Action are included in the extensive network of ephemeral dendritic drainages that feed into USGS blue line drainages (**Figure 3.3 – Figure 3.7**). These “blue line”, ephemeral drainages feed

into Chaco Wash to the west or Blanco Wash to the north. There is no evidence of permanent surface water within the Proposed Action area, such as rivers, streams, lakes, ponds, springs, or wetlands.

Jurisdictional waters of the U.S. are regulated by the USACE. However, the Navigable Waters Protection Rule of April 21, 2020 specifically determined that ephemeral drainages, which only flow as a result of discrete precipitation events, are not regulated under section 404 of the Clean Water Act. Therefore, all ephemeral drainages in the parcels would not be regulated by the USACE at this time, but current BLM resource management plan guidance does provide the BLM with site specific project review to protect and minimize impacts to ephemeral water features.

On January 20, 2021, an EO was signed revoking Executive Order 13778 of February 28, 2017 (Restoring the Rule of Law, Federalism, and Economic Growth by Reviewing the "Waters of the United States" Rule), and at the time of this document's preparation it is unknown how the EPA and Department of the Army will be revisiting the definition of a water of the U.S.

3.7.2 Impacts from the Proposed Action

Direct and Indirect Impacts

There would be no direct impacts to the currently existing hydrologic resources on any of the parcels included in the Proposed Action. The leasing action is solely an administrative process and subsequent NEPA analysis and permit approval would be required for future oil and gas development and production activities that may occur as a result of the leasing action.

Indirect impacts include the reasonably foreseeable energy development that is likely to occur on the parcels as a result of the leasing action. Foreseeable development consists of one to two wells per parcel depending on hydrocarbon potential (**Table 2.2** & **Table 2.3**). The well(s) would be collocated on a single well pad and would also include the construction of an access road to the well pad.

The vulnerability of aquifers is a function of the depth to groundwater and the permeability of the overlying soils. The soils in the project area generally have a moderately high to high transmissibility to water (Ksat)[10] (see **Section 3.8 Soils**), and the depth to groundwater is approximately 200 feet. It is unlikely that surface development would have any impact on the underlying Uinta-Animas aquifer, due to the presence of intervening impermeable geological layers and the depth to groundwater. However, development of the oil and gas resources would necessitate the drilling of wellbores through the Uinta-Animas aquifer to reach the underlying target formations. Prior to drilling, the lease owner or operator would be required to submit a complete APD package in accordance with requirements under Onshore Oil and Gas Orders listed in 25 CFR 212, including a drilling plan with design features deemed sufficient by BLM, including casing, cementing, and other design features to isolate the aquifer from the wellbore. These design features would be brought forth from the NEPA document associated with the APD submittal and attached as COAs for each proposed exploration and development activity authorized on a lease.

Potential impacts to surface waters from construction activities would include direct disturbance from construction activity, or indirect impacts from uncontrolled spills and potential discharges that reached ephemeral channels. These impacts could mobilize surface sediments to a greater extent than current conditions and could also degrade the water quality of the ephemeral flows from these drainages.

Those ephemeral drainages that exhibit indicators of consistent flow (an Ordinary High-Water Mark [OHWM]) would be reviewed by the BLM, which may apply stipulations to protect or minimize impacts to these features at the time of APD submittal, as shown in **Figure 3.3 – Figure 3.7.** At the time of writing this EA, the EPA and Department of the Army are reviewing the definition of a water of the U.S.

In summary, the existing regulatory structure makes it unlikely that construction would be permitted within the boundaries of the major washes (Blanco Wash, Kimbeto Wash, and Escavada Wash). Construction would be expected to mostly avoid the unnamed ephemeral features to the greatest extent practicable, and where impacts were unavoidable, mitigation measures and design features would be required to reduce the risk of erosion and degradation.

[10] Data available at https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx, accessed March 2020

Figure 3.3 Water Resources Map A

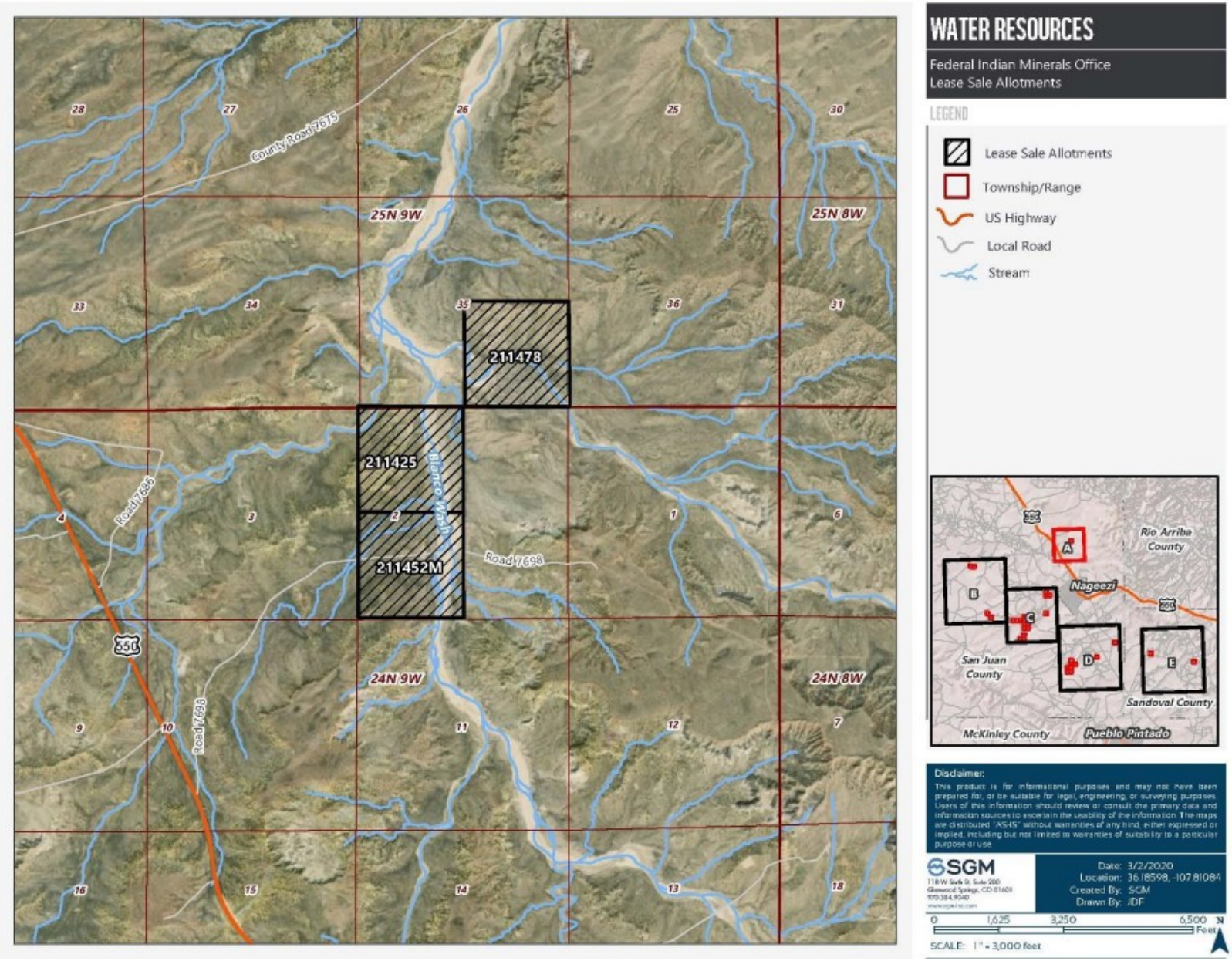


Figure 3.4 Water Resources Map B

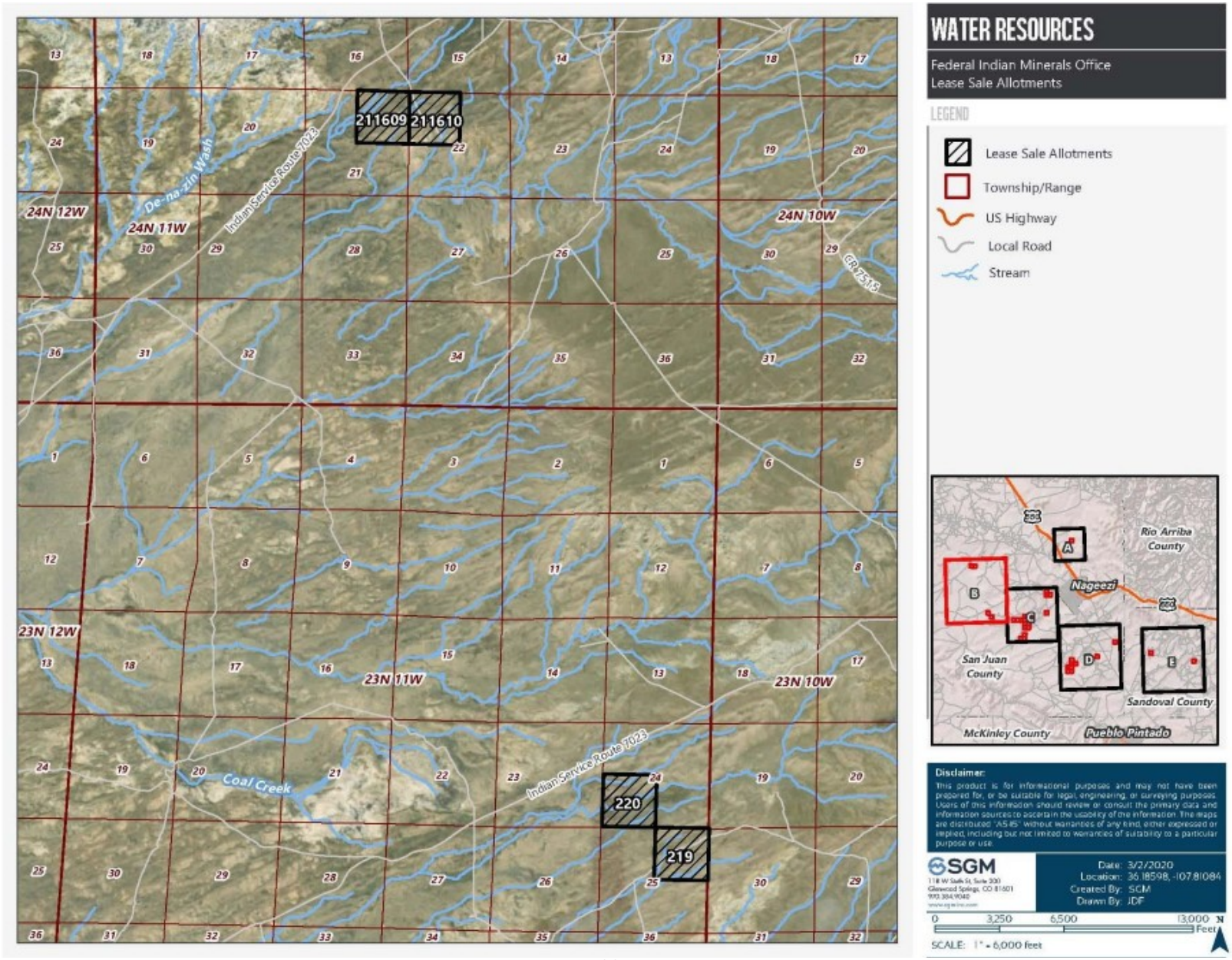


Figure 3.5 Water Resources Map C

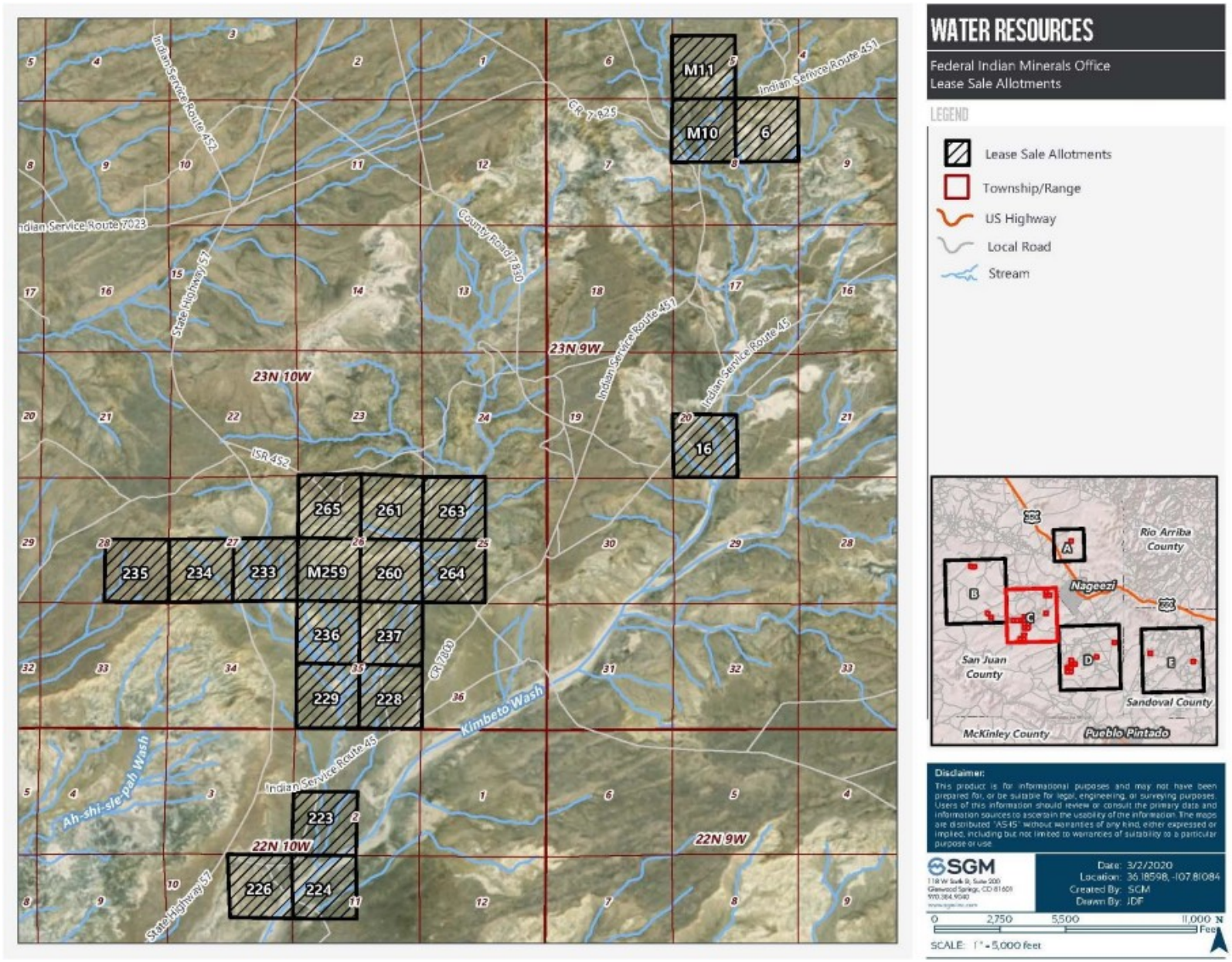


Figure 3.6 Water Resources Map D

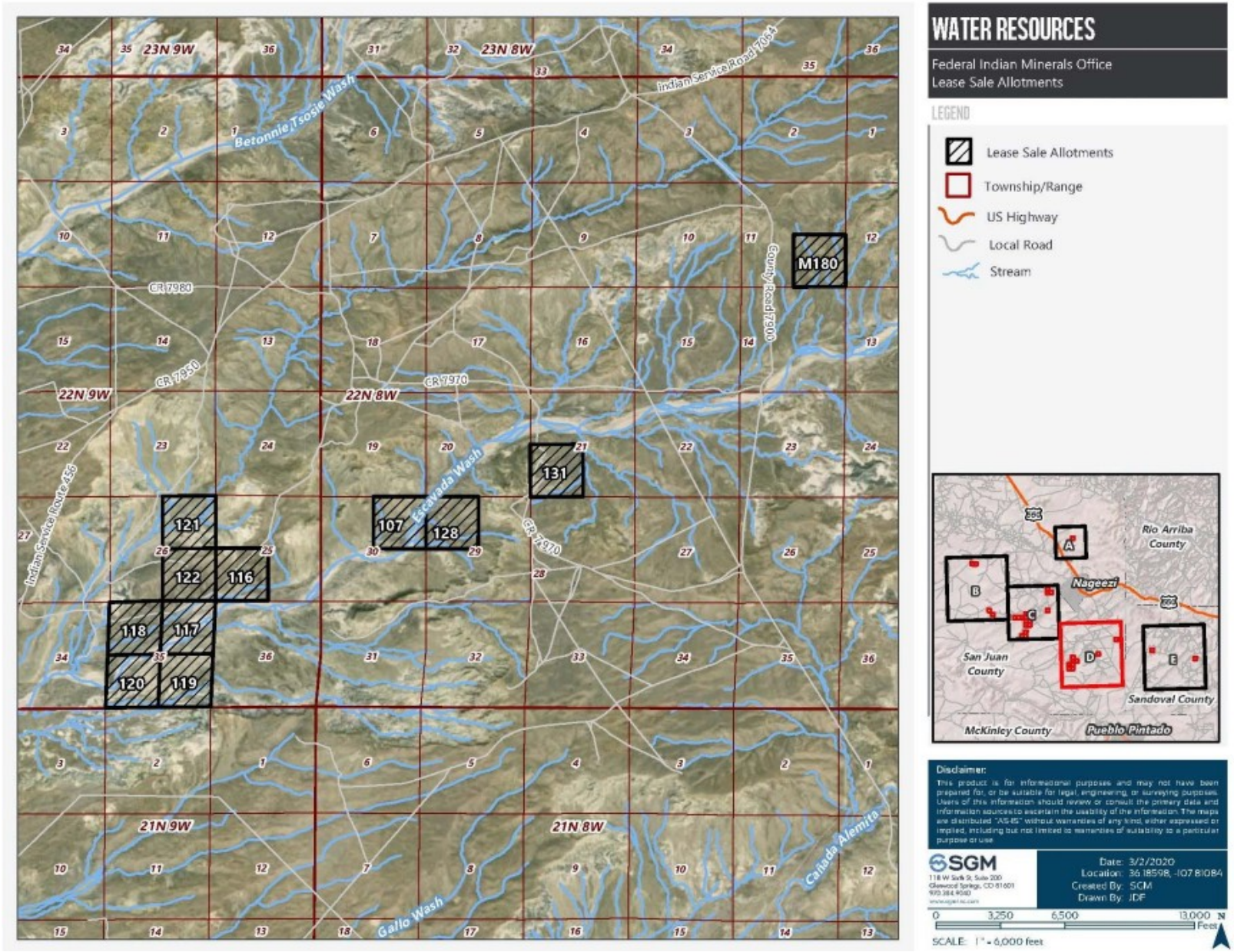
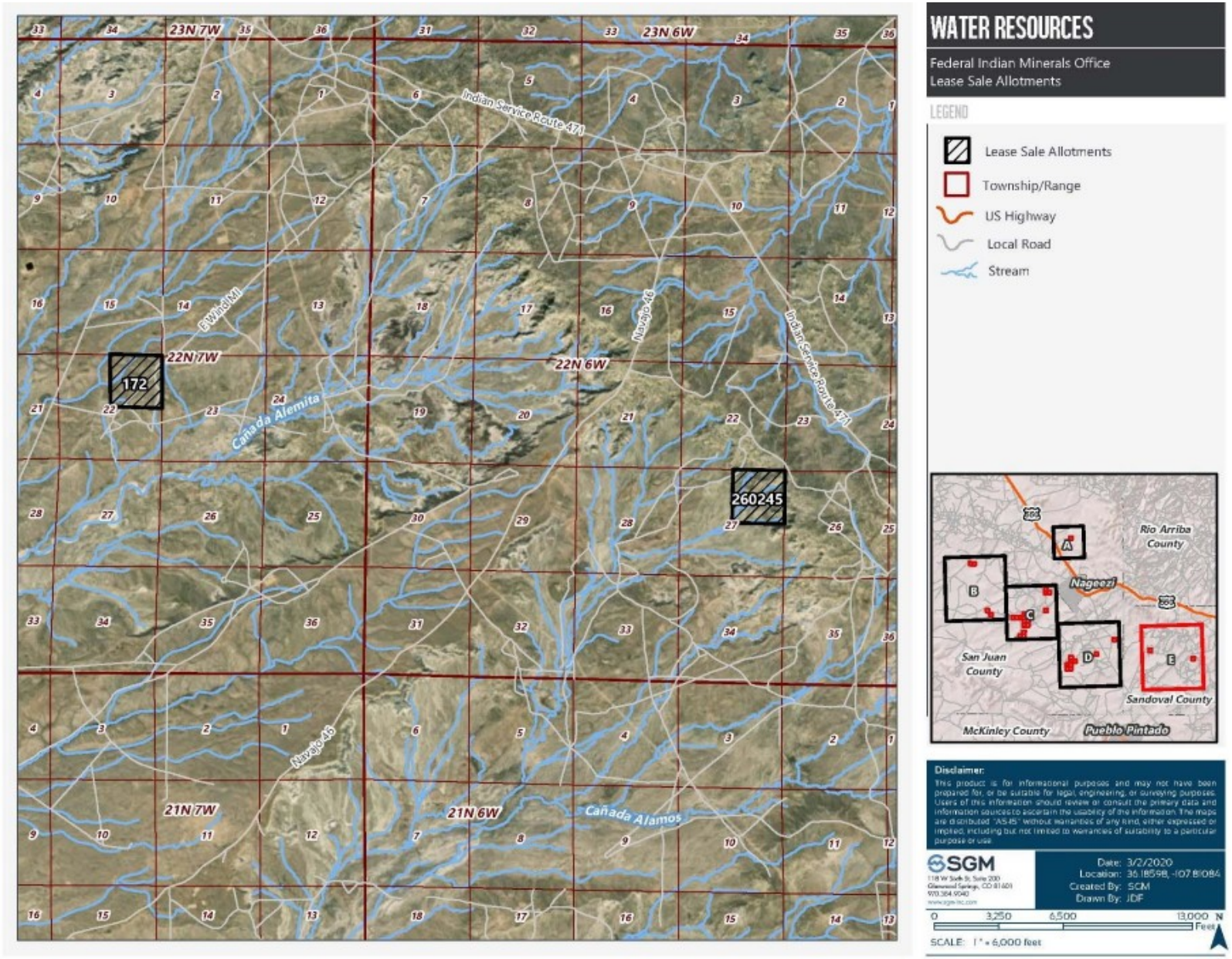


Figure 3.7 Water Resources Map E



3.8 Paleontological Resources

3.8.1 Affected Environment

Four parcels are located 0.5 miles or less from the boundaries of the Betonnie Tsosie Fossil Area, designated by the FFO RMP (BLM 2003a). These parcels include 6, M10, M11, and 15. One additional parcel (M180) is within 0.5 miles of the Lybrook Fossil Area, another FFO Specially Designated Area that is adjacent to Betonnie Tsosie Fossil Area.

These areas were designated to protect badland topography exposures of the Nacimiento geological formation, which is known to contain Paleocene-age faunal fossils. The management objectives are to facilitate scientific study and protection of the paleontological resources.

None of the parcels in the Proposed Action are within the designated Fossil Areas, but the surficial geology of the entire Proposed Action area consists of the Nacimiento, Kirtland, and Fruitland formations, all of which have high potential to yield paleontological resources (Green and Jones 1997). Parcels 6 and M11 specifically include significant exposures of the badland-forming members of the Nacimiento formation and are geologically similar to the areas preserved in the Fossil Areas.

3.8.2 Impacts from the Proposed Action

Direct and Indirect Impacts

There would be no direct impacts to the currently existing paleontological resources on any of the parcels included in the Proposed Action. The leasing action is solely an administrative process and subsequent NEPA analysis and permit approval would be required for future oil and gas development and production activities that may occur as a result of the leasing action.

Indirect impacts include the surface disturbance associated with reasonably foreseeable energy development that is likely to occur on the parcels as a result of the leasing action. Foreseeable development consists of one to two wells per parcel depending on hydrocarbon potential (**Table 2.2** & **Table 2.3**). The well(s) are forecast to be co-located on a single well pad and would also include the construction of an access road and pipeline corridor to the well pad.

The level of risk to fossil resources is a function of the extent of bedrock disturbance to formations that are known or likely to contain paleontological resources from construction of the likely well pad and access road/pipeline corridor. Bedrock excavation in the Proposed Action does have the potential to expose or negatively impact paleontological resources, since the area is known to have significant resources in the shallow bedrock layers of the Nacimiento, Kirtland and Fruitland formations.

Prior to drilling, the lease owner or operator would be required to submit a complete APD package, and the access road and pad designs in that APD would be required to conform to the standards of the BLM's Gold Book (BLM 2007). These include guidelines that restrict surface disturbance to the minimum extent required, and that limit the amount of cut and fill in the design of the facilities as much as possible. In addition to these general measures limiting excavation, the APD would be evaluated by BLM paleontological resource specialists. If a specific development plan was determined to present a significant risk to fossil resources, the BLM and FIMO would apply additional protective stipulations, potentially including pre-construction surface surveys, site avoidance, and/or the presence of a paleontological monitor during excavations. These stipulations would be brought forth from the NEPA document associated with the APD submittal and attached as COAs for each proposed exploration and development activity authorized on a lease.

3.9 Soils

The National Resources Conservation Service (NRCS) lists 14 soil types within the 6,402.04 acres included in the Proposed Action (**Table 3.23**). The soil types and extents given are for the parcels, and do not account for the fact that likely disturbance would be confined to only a small portion of each parcel.

In summary, the Project is dominated by coarse to fine loams. The soils are generally well drained, with moderately high or high hydraulic conductivity and low to medium runoff potential. The exception are the Badlands soils (BA, 5.32%) which are clay soils with extremely high runoff potential. Extensive areas of biological soil crusts or cryptobiotic soils are not known to be present, or expected based on the underlying substrates, climate conditions, and land use history.

While there were no known areas of notable biological crusts, the soil types in the area are susceptible to compressional damage from vehicle traffic and construction activities. Disruption of abiotic soil crusts can result in decreased soil organism diversity, soil nutrient levels, soil stability, and organic matter. The biological components found in arid coarse soils, such as those that occur in the Proposed Action, typically are dominated by large filamentous cyanobacteria, and do not support the density or diversity of microorganisms found in more finely textured soils. The cyanobacteria that are present contribute to stabilizing the soil surface, contribute to available nitrogen and soil moisture levels, and their populations are susceptible to degradation from disturbance and soil compression associated with construction. It would likely take several years for cyanobacteria populations to reestablish in disturbed areas but the existence of undisturbed soil surrounding the parcels should provide source populations to aid re-establishment.

3.9.1 Impacts from the Proposed Action

Direct and Indirect Impacts

There would be no direct impacts to the currently existing soil conditions resources on any of the parcels included in the Proposed Action. The leasing action is solely an administrative process and subsequent NEPA analysis and permit approval would be required for future oil and gas development and production activities that may occur as a result of the leasing action.

Indirect impacts include the reasonably foreseeable energy development that is likely to occur on the parcels as a result of the leasing action. Foreseeable development consists of one to two wells per parcel depending on hydrocarbon potential (**Table 2.2** & **Table 2.3**). The well(s) would be co-located on a single well pad and would also include the construction of an access road to the well pad.

The level of risk to soil resources is a function of the erosiveness of the soils, the intensity of erosive agents such as wind and water, and the presence of any special factors such as biological soil crusts. There is a high likelihood for wind- or water-driven soil erosion in the area of the Proposed Action, given the prevailing climatic conditions and the low level of existing vegetative cover. The cyanobacteria that are likely present in the upper soil layers contribute to stabilizing the soil surface, contribute to available nitrogen and soil moisture levels, and their populations are susceptible to degradation from disturbance and soil compression associated with construction. It would likely take several years for cyanobacteria populations to reestablish in disturbed areas but the existence of undisturbed soil surrounding the parcels should provide source populations to aid re-establishment.

Impacts to soil resources during the foreseeable energy development can be reduced by standard practices such as utilizing existing surface disturbance areas (e.g., existing roads), minimizing vehicular use, placing parking and staging areas on caliche-surfaced areas, and quickly establishing vegetation on reclaimed areas.

Prior to drilling, the lease owner or operator would be required to submit a complete APD package, and the plan of development in that APD would be required to conform to the standards of the BLM's Gold Book (BLM 2007). These include guidelines for site preparation, reclamation, and revegetation. The Gold Book also mandates interim reclamation of all disturbed areas not required for production operations, final reclamation of all disturbance once the well has reached the end of its useful life, and monitoring of the success and stability of the reclamation efforts. In general, the construction of the well pad and access road would necessitate removing topsoil layers and compacting subsoil layers on approximately 6.85 acres or 4.2% of each parcel. Topsoil is generally segregated and stockpiled during the construction process and used for reclamation and revegetation on the temporary disturbance areas (pipelines, pad cut-and-fill slopes). The BLM-mandated stabilization and reclamation requirements would be expected to substantially reduce the level of soil erosion caused by reasonably foreseeable development.

Table 3.22 Soil Types and Extent in Proposed Action

Soil Type Name	Map Unit Symbol	Percent of Proposed Action	Special Designations
Badland	BA	5.32%	Extremely high runoff potential
Blancot-Councelor-Tsosie association, 0 to 5 percent slopes	270	1.57%	
Blancot-Lybrook association, 0 to 8 percent slopes	101	0.96%	
Blancot-Notal association, gently sloping	BT	55.90%	
Councelor-Eslendo-Mespun complex, 5 to 30 percent slopes	180	0.26%	
Doak-Avalon association, gently sloping	DN	0.01%	
Doak-Sheppard-Shiprock association, rolling	DS	7.69%	
Doakum-Betonnie fine sandy loams, 0 to 8 percent slopes	150	1.13%	
Fruitland-Persayo-Sheppard complex, hilly	FX	11.79%	
Riverwash	RA	6.03%	Hydric Soil
Rock outcrop-Vessilla-Menefee complex, 30 to 40 percent slopes	220	1.38%	
Sheppard-Huerfano-Notal complex, gently sloping	SC	2.75%	
Stumble-Notal complex, gently sloping	SX	5.16%	Farmland of statewide importance
Vessilla-Menefee-Orlie association, 0 to 30 percent slopes	422	0.05%	
Total Proposed Action Area		**100%**	

3.10 Socioeconomics & Environmental Justice

The area for this proposed lease sale is home to a wide variety of cultural, ethnic, and tribal communities. The American Indian populations in the proposed project area are considered indigenous groups. The following discussion provides a descriptive summary of the human populations of the study area, their age and gender distribution, income levels, and ethnic and cultural affiliations. These data are provided as a context for analyzing what economic or social effects the proposed action may have on the residents of the study area, and if low income, minority, and local communities may be disproportionately affected. This discussion is confined to the population of San Juan County, which hosts the large majority of the Allotments in the Proposed Action, and the residents and workforce in the area that would be affected by the Proposed Action. Sandoval County population statistics are not further discussed since there are no reasonably foreseeable significant impacts to the socioeconomic conditions prevalent in Sandoval County as a result of the Proposed Action.

The total population of the study area is relatively low, compared to more urbanized areas in the surrounding region, such as the Albuquerque and Phoenix metropolitan areas. The populations of the study area are relatively stable in both size and composition and exhibit an age and gender distribution similar to that of New Mexico in general (EPS 2020).

The proposed lease sale analyzed in this EA is relatively small and is not anticipated to cause large increases in employment or area populations. The lease sale itself is not anticipated to cause any significant impacts to demand for local government services, infrastructure, or housing. Given the high proportion of different ethnic and cultural groups in the proposed project area, FIMO considers how agency authorized, permitted, or funded actions may affect minority, low-income, and local communities.

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations, requires that federal agencies identify and address any disproportionately high and

adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. The BLM, BIA, CEQ, and EPA guidance, however, do not provide a quantitative threshold18 for determining whether a population should be considered low income. For this analysis, the percentage of persons in poverty in the study area is compared with that of the state.

Environmental justice refers to the fair treatment and meaningful involvement of people of all races, cultures, and incomes with respect to the development, implementation, and enforcement of environmental laws, regulations, programs, and policies. It focuses on environmental hazards and human health to avoid disproportionately high and adverse human health or environmental effects on minority, low-income and American Indian populations of concern.

Guidance on environmental justice terminology developed by the President's Council on Environmental Quality (CEQ 1997) is discussed below.

- Low-income population. A low-income population is determined based on annual statistical poverty thresholds developed by the US Census Bureau. In 2019, poverty level is based on total income of $12,490 for an individual and $25,750 for a family of four (Census Bureau 2020). A low-income community may include either a group of individuals living in geographic proximity to one another or dispersed individuals, such as migrant workers or Native Americans.
- Minority. Minorities are individuals who are members of the following population groups: American Indian, Alaskan Native, Asian, Pacific Islander, Black, or Hispanic.
- Minority population area. A minority population area is so defined if either the aggregate population of all minority groups combined exceeds 50 percent of the total population in the area or if the percentage of the population in the area comprising all minority groups is meaningfully greater than the minority population percentage in the broader region. Like a low-income population, a minority population may include either individuals living in geographic proximity to one another or dispersed individuals.
- Comparison population. For the purpose of identifying a minority population or a low-income population concentration, the comparison population used in this study is the state of New Mexico.

Low-Income Population

The poverty rate in San Juan County in 2018 was 23.1%, somewhat elevated compared to 18.8% for the State of New Mexico as a whole, and approximately double the national poverty rate of 11.8%. Similarly, estimates from 2018 (Census Bureau) indicate that San Juan County had a household median income of $46,578, slightly lower than the rate of $47,405 for the State of New Mexico, and dramatically lower than the national average household income of $61,937. Based on the CEQ definitions, San Juan County qualifies as a low-income population. Low-Income populations are defined by the US Census Bureau (2019-2020) as persons living below the poverty level.

Minority Population

Based on 2019 data, minorities make up approximately 62% of the population of San Juan County, with the single ethnic group of Native Americans accounting for approximately 41% of the total. The proportion of minorities in the socioeconomic study area substantially exceeds the national average and is slightly higher than the average for the State of New Mexico. Based on the CEQ definitions, San Juan County qualifies as a minority-population community.

Table 3.23 Demographic Data for San Juan and Sandoval Counties, New Mexico

Population Total	San Juan County		Sandoval County		New Mexico	
	Population	Percent (%)	Population	Percent (%)	Population	Percent (%)
Total Population	121,661	5.7	148,834	7.0	2,117,522	
Hispanic or Latino (% of total)	23,630	19.4	57,617	38.7	1,010,811	47.7
White alone (% of total)	50,416	41.4	81,521	54.8	1,078,937	51.0
Black or African American alone	714	0.6	3,327	2.2	45,904	2.2

American Indian and Alaska Native alone	50,021	41.1	18,314	12.3	212,241	10.0
Asian alone	916	0.8	2,545	1.7	37,469	1.8
Native Hawaiian and other Pacific Islander alone	71	0.1	265	0.2	2,093	0.1
Some Other Race	8,456	7.0	15,768	10.6	318,632	15.0
Two or More Races	11,067	9.1	27,094	18.2	422,246	19.9
People with income below poverty level	50,518	19.9	63,802	10.0	49,754	18.2

Source: U.S. Census Bureau American Community Survey (U.S. Census Bureau 2019-2020) 5-year estimates; Income data-www.census.gov (4-year estimates 2019-2020)

3.10.1 Impacts from the Proposed Action

Direct and Indirect Impacts

While the act of leasing Indian allotted minerals itself would not result in significant social or economic impacts, subsequent development of a lease may generate impacts to people living near or using the areas in the vicinity of the lease allotments. 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. Should APDs be filed for the lease allotment(s) considered in this sale, then the social and economic effects on adjacent populations would be assessed relative to known impacts.

At the lease sale stage, there is often not enough information available about how the lease will be developed to accurately determine whether there may be disproportionately high and adverse environmental justice impacts to identified populations of concern. Exact locations and equipment specifications are known at the APD stage, so the site-specific (APD) EA should assess whether there are disproportionately high and adverse impacts to identified environmental justice populations from the development of these leases.

The current population of the allotments should be considered an environmental justice population of concern and should be addressed accordingly in any additional environmental analyses undertaken at the site-specific (APD) stage. The current residents of the allotments proposed for sale in this action may reasonably be defined as a discrete, though dispersed, local community for purposes of determining if disproportionately high and adverse environmental effects may be present at the APD stage.

Should APD application be submitted for potential development for these allotments, residents would be given the opportunity to identify any environmental effects that might arise from development activities that they feel have a disproportionately high and adverse effect. These effects include, but are not limited to, increased noise, increased dust, and perceived threat from increased traffic in the area, disruption of quality-of-life factors, such as sense of isolation or privacy, and other issues. It is important to note that most disproportionate and adverse environmental effects must be defined by the group that would suffer such effects.

FIMO must provide these affected environmental justice populations reasonable opportunities to identify such affects and would collaborate with the affected populations to determine possible mitigation methods and measures. FIMO cannot identify and mitigate any identified disproportionate and adverse effects unilaterally, but rather must do so in collaboration with the affected communities.

The amount of disruption would depend on the activity affected, proximity, traffic patterns within the area, noise levels, length of time, and season these activities occurred. In addition, any nearby residents may be disturbed while drilling, hydraulic fracturing or other completion and stimulation operations are occurring, as these activities involve many vehicles, heavy equipment, and variously sized drilling/workover rigs. These impacts would be limited to the period of time during which drilling operations associated with hydraulic fracturing occur.

Due to occupied residences located within several allotments, protective lease stipulations (see Appendix A, BIA-2) applicable to residential areas or improvements would be included in the APD permit approval. CFR 25 212.47 states that no surface occupancy is allowed within 200 feet of any occupied residences of

a community to reduce impacts to the community from drilling and production activities; however, impacts from these activities can extend much further than 200 feet.

All Navajo Nation Chapters have been identified as populations for further environmental justice consideration. Potential for development in these areas was examined to determine populations where impacts would be more likely to occur. The area of greatest development potential is in the central-southern portion of the planning area surrounding the communities of Navajo chapters of Huerfano, Nageezi, and Counselor. High potential areas are also within the Huerfano chapter boundary. Environmental justice populations in areas of high development potential are more likely to be affected.

Air quality is determined by the quantity and chemistry of atmospheric pollutants in consideration of meteorological factors (i.e., weather patterns) and topography, both of which influence the dispersion and concentration of those pollutants. The presence of air pollutants is due to a number of different and widespread sources of emissions. The analysis area of impacts on air quality consists of San Juan, Sandoval, Rio Arriba, and McKinley Counties. This spatial scope of analysis was identified based on the regional nature of air pollution and to facilitate analysis using the best available air quality data, which are generally provided at the county level.

3.11 Special Designations

Sixteen (16) of the parcels included in the Proposed Action are 0.5 miles or less from areas that have special designations within the FFO RMP (BLM 2003a). The parcels of concern and the relevant special designations are listed below in **Table 3.24.** Special designations within the FFO RMP only apply to federal lands, and do not apply to the Allotments. However, the leasing of the Allotments that are in proximity does have the potential to impact the resources recognized and protected within the special designations.

Table 3.24 Allotments in Proximity to Special Designation Areas

Allotment	Special Designation	Proximity
6	Betonnie Tsosie Fossil Area	<0.5 miles from boundary
M10	Betonnie Tsosie Fossil Area	<0.5 miles from boundary
M11	Betonnie Tsosie Fossil Area	<0.5 miles from boundary
16	Betonnie Tsosie Fossil Area	~0.5 miles from boundary
M180	Lybrook Fossil Area	~0.5 miles from boundary
220	North Road (Chacoan Road Segment #4) ACEC	Adjacent to boundary
223	Ah-shi-sle-pah Wilderness	<0.5 miles from boundary
224	Ah-shi-sle-pah Wilderness	<0.5 miles from boundary
226	Ah-shi-sle-pah Wilderness	<0.5 miles from boundary
229	Ah-shi-sle-pah Wilderness	<0.5 miles from boundary
233	Ah-shi-sle-pah Wilderness	Adjacent to boundary
234	Ah-shi-sle-pah Wilderness	Adjacent to boundary
235	Ah-shi-sle-pah Wilderness	Adjacent to boundary
236	Ah-shi-sle-pah Wilderness	<0.5 miles from boundary
259	Ah-shi-sle-pah Wilderness	<0.5 miles from boundary
211609	Bisti/De-Na-Zin Wilderness	<0.5 miles from boundary

Only one parcel falls within the boundaries of FFO Special Designation: Allotment 220 is within the cultural resource, North Road (Chacoan Road Segment #4), Area of Critical Environmental Concern (ACEC). An ACEC is an area that is highlighted for special management attention to protect and prevent irreparable damage to important historic, cultural, and scenic values, fish, or wildlife resources or other natural systems or processes; or to protect human life and safety from natural hazards. An ACEC must meet the criteria of relevance and importance as established and defined in 43 CFR 1610.7-2, and BLM Manual 1613 (Areas of Critical Environmental Concern). Note that BLM ACEC designations are an internal regulatory

designation, and the management prescriptions for the North Road ACEC do not apply on the inholding of Allotment 220.

3.11.1 Impacts from the Proposed Action

Direct and Indirect Impacts

There would be no direct impacts to the special designations, or to the resources contained within them as a result of leasing the parcels included in the Proposed Action. The leasing action is solely an administrative process and subsequent NEPA analysis and permit approval would be required for future oil and gas development and production activities that may occur as a result of the leasing action.

Indirect impacts include the reasonably foreseeable energy development that is likely to occur on the parcels as a result of the leasing action. Foreseeable development consists of one to two wells per parcel depending on hydrocarbon potential (**Table 2.2** & **Table 2.3**). The well(s) are forecast to be co-located on a single well pad and would also include the construction of an access road and pipeline corridor to the well pad.

The level of risk to is a function of the vulnerability of the resources in each designated area to oil and gas development within close proximity. Each special designation is discussed separately:

- The paleontological resources protected within the Betonnie Tsosie and Lybrook Fossil Areas are not vulnerable to degradation from nearby development. None of the parcels are directly adjacent to the Fossil Areas, and there is no foreseeable mechanism by which oil and gas development would impact *in situ* fossils on protected lands approximately 0.5 miles away. Concerns related to these Fossil Areas are discussed further in **Section 3.8**.
- The cultural resources protected within the North Road ACEC are not vulnerable to degradation from nearby development. There is no foreseeable mechanism by which oil and gas development on Allotment 220 would impact *in situ* archaeological values on protected lands approximately 0.5 miles away. However, the North Road ACEC is vulnerable to degradation from development on Allotment 219, which is within the boundaries of the ACEC. Oil and gas development on this parcel would involve surface disturbance that could damage cultural resources. The risk of significant impact is heightened by the nature of the resources within the North Road ACEC which protects a linear feature that derives meaning and value from its continuous nature. Development has the potential to disrupt that continuity. In recognition of this risk, the FFO has designated the ACEC as an area of discretionary closure to new leasing, with a portion open to leasing but with a No Surface Occupancy stipulation (BLM 2003a). Concerns related to this area and the traditional cultural property (TCP) are discussed further in **Section 3.5.** The wilderness values protected within the Ah-shi-sle-pah Wilderness are vulnerable to degradation from nearby development. The Wilderness was designated to protect wilderness characteristics, including naturalness, and opportunities for solitude and primitive or unconfined recreation. Due to the open topography and lack of screening vegetation in the Wilderness, it is likely that oil and gas development would be apparent (visible and/or audible) from within the Wilderness, especially for the immediately adjacent parcels (Allotments 223, 224, and 225). Development in the surrounding area has the potential to degrade the inventoried wilderness characteristics. The FFO manages the Wilderness Area as an area of non-discretionary closure to new leasing in compliance with the non-impairment standards of the Wilderness Act of 1964 (BLM 2003a).
- The wilderness values protected within the Bisti/De-Na-Zin Wilderness Area are vulnerable to degradation from nearby development. The Wilderness Area was designated to protect wilderness characteristics, including naturalness, and opportunities for solitude and primitive or unconfined recreation. Due to the open topography and lack of screening vegetation in the Wilderness Area, it is possible that oil and gas development would be apparent (visible and/or audible) from within the Wilderness Area, especially during the construction and drilling phases. Extensive development in the surrounding area has the potential to degrade the inventoried wilderness characteristics. The FFO manages the Wilderness Area as an area of non-discretionary closure to new leasing in compliance with the non-impairment standards of the Wilderness Act of 1964 (BLM 2003a).

Mitigation Measures

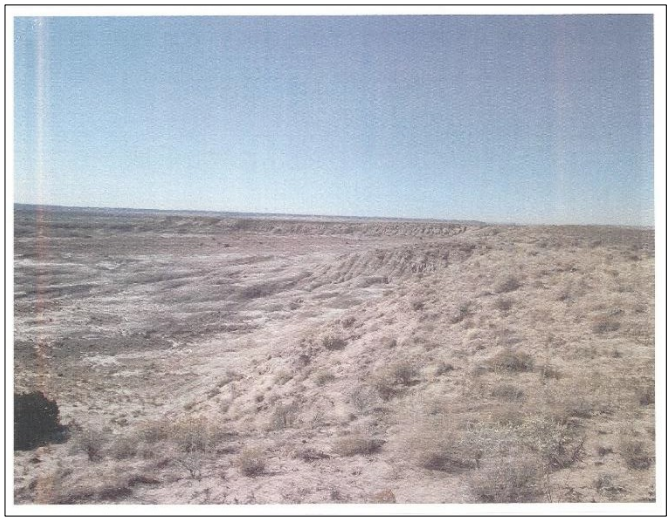
Although there is the potential for significant impacts to special designations on federal lands in the vicinity of some of the parcels included in the Proposed Action, none of the parcels are actually within the special designation boundaries, or the parcel is an inholding that falls outside the jurisdiction of the designation (Allotment 219 within the North Road ACEC). Until a complete APD package is analyzed, determining appropriate mitigation measures would not likely be relevant.

Therefore, no mitigation measures are proposed at this time to mitigate against the potential indirect effects of leasing Allotment lands that are in proximity to BLM special designations.

3.12 Vegetation and Special Status Plant Species

3.12.1 Affected Environment

Vegetation Communities



The Proposed Action is within the San Juan/Chaco Tablelands and Mesas level IV ecoregion, which is within the Arizona/New Mexico Plateau level III ecoregion (Griffith et al. 2006). Typical vegetation in the region is a mix of desert scrub, semi-desert shrub-steppe, and semi-desert grasslands. Shadscale, fourwing saltbush, Mormon tea, Indian ricegrass, galleta, and blue and black grama grass are dominant in many areas. It is more arid, has generally lower elevations, and a lower percentage of pinyon-juniper cover than surrounding areas. Most of the parcels contain little or no pinyon-juniper vegetation. Vegetation community typesmapped by the National Landcover Dataset within the Proposed Action are limited toherbaceous and scrub-shrub cover (**Figure 3-8**).

FIMO conducted field inspections of the parcels in the Proposed Action that confirmed these desktop assessments. Some areas also had a significant component of big sagebrush in the vegetation. Pinyon-juniper woodlands were absent from the Proposed Action area.

Special Status Plant Species

Based on information from the U.S. Fish and Wildlife Service (USFWS), the BLM and Navajo Nation Department of Fish and Wildlife (NNDFW), there are no federally listed species known to occur in proximity to the Proposed Action: Three special status plant species have the potential to occur in the vicinity: San Juan milkweed, Aztec gilia (*Aliciella formosa*) and Clover's hardwall cactus. All three species are included on the Navajo Endangered Species List (NESL) as Group 4 species but are not federally listed under the Endangered Species Act. Group 4 NESL species do not have legal protections. There is no habitat in proximity to the Proposed Action for any federally listed species that occur in the surrounding area. There is no federally designated Critical Habitat within or adjacent to the Proposed Action.

3.12.1 Impacts from the Proposed Action

Direct and Indirect Effects

The Proposed Action would not directly impact special status plant species within the vicinity of the Proposed Action, since no ground-disturbing activities are required as a component of the leasing action, which is solely an administrative process. Subsequent NEPA analysis and permit approval would be required for future oil and gas development and production activities that may occur as a result of the leasing action.

The six (6) parcels including Allotments **117**, **118**, **119**, **120**, **121**, and **122** are in proximity to known locations of San Juan milkweed, a Navajo Endangered Species. As a result, avoidance of this species habitat would be expected in any plan of development, including the submittal of an APD/NOS to the BLM.

All other parcels included in the Proposed Action have the potential to support San Juan milkweed, Aztec gilia, and Clover's cactus. Any new proposed ground disturbance as a result of the Proposed Action would require a biological evaluation to determine the impacts, if any from the development. These species may not have any legal protection but disclosing impacts to these species is important to avoid up-listing these species to more protective categories in the future. Biological surveys prior to any ground-disturbing activities will be required to determine habitat suitability. In 2020, Clover's cactus and Aztec gilia has been petitioned for protection under the Endangered Species Act (ESA). If these two species are deemed warranted for listing under ESA, any future development from the Proposed Action will be subjected to Section 7 consultation, as written in ESA and BLM Manual 6840.

Seven (7) parcels including Allotments **6**, **M10**, **M11**, **172**, **M180**, **211609**, and **211610** are within known suitable habitat for Clover's cactus (**Figure 3.8**), where the species is known to occur. On BLM-administered lands, when individual plants or suitable habitat for Clover's cactus are found during a biological survey for a ground-disturbing project such as oil and gas development, the BLM/FFO may require that the company proposing the project avoid suitable habitat. If avoidance is not feasible, transplanting Clover's cactus may be authorized, if approved by NMSO and permit acquired by the State of New Mexico. Aztec gilia suitable habitat is avoided where feasible.

The Proposed Action would not directly impact vegetation cover or habitat types since no ground-disturbing activities are required as a component of the administrative process of leasing action.

Indirect impacts include the reasonably foreseeable energy development that is likely to occur on the parcels as a result of the leasing action. Foreseeable development consists of one to two wells per parcel depending on hydrocarbon potential (**Table 2.2** & **Table 2.3**). The well(s) would be co-located on a single well pad and would also include the construction of an access road to the well pad. This is estimated at approximately 6.85 acres or 4.2% of each Allotment.

Complete development of all 40 parcels would result in the disturbance of approximately 278 acres of surface, distributed across the 40 parcels. Much of the 278 acres could potential be suitable habitat for one or more special status plant species. This disturbance would consist almost entirely of herbaceous semi-desert grasslands and semi-desert shrub/scrub vegetation (**Figure 3.8**).

Subsequent NEPA analysis and permit approval would be required for this foreseeable oil and gas development and would include reclamation and revegetation plans conforming to the standards of the BLM's Gold Book (BLM 2007). These include guidelines for site preparation, reclamation, and revegetation. The Gold Book also mandates interim reclamation of all disturbed areas not required for production operations, final reclamation of all disturbance once the well has reached the end of its useful life, and monitoring of the success and stability of the reclamation efforts.

Reclamation seeding would consist of a mix of native grasses specified by the BLM and FIMO, or by the Allottee/lessor/grazing rights holder as applicable. Given site soils and climate, establishment of self-sustaining populations of desirable native grasses, forbs, and shrubs would require multiple growing seasons. Establishment of desirable herbaceous vegetation on disturbed areas sufficient to minimize erosion by wind or water and invasion by weeds could be anticipated to occur within 3 to 5 years. Annual monitoring and weed control, with follow-up re-seeding if necessary, would be required until the reclamation achieves BLM and FIMO approval.

Figure 3.8 Vegetation

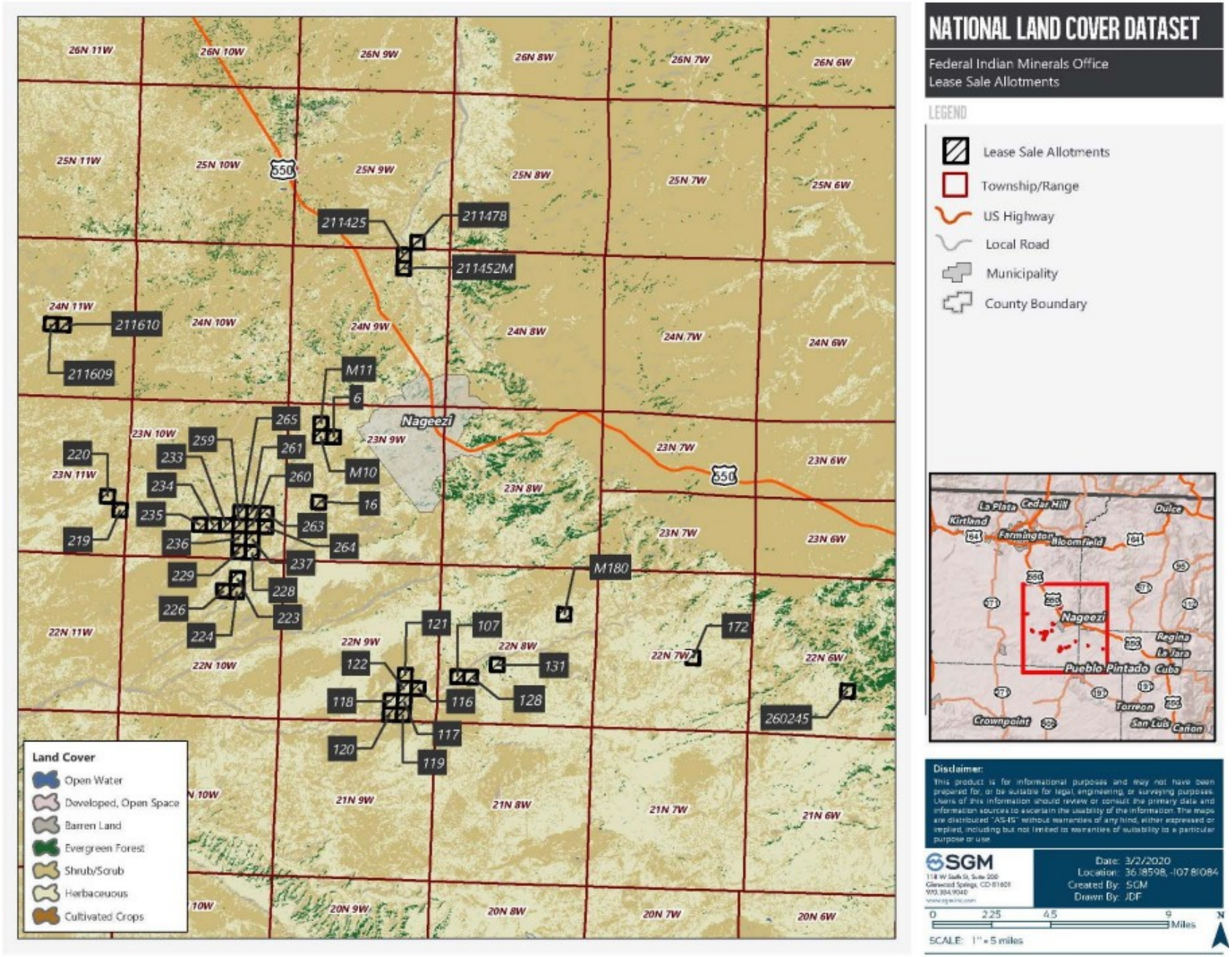
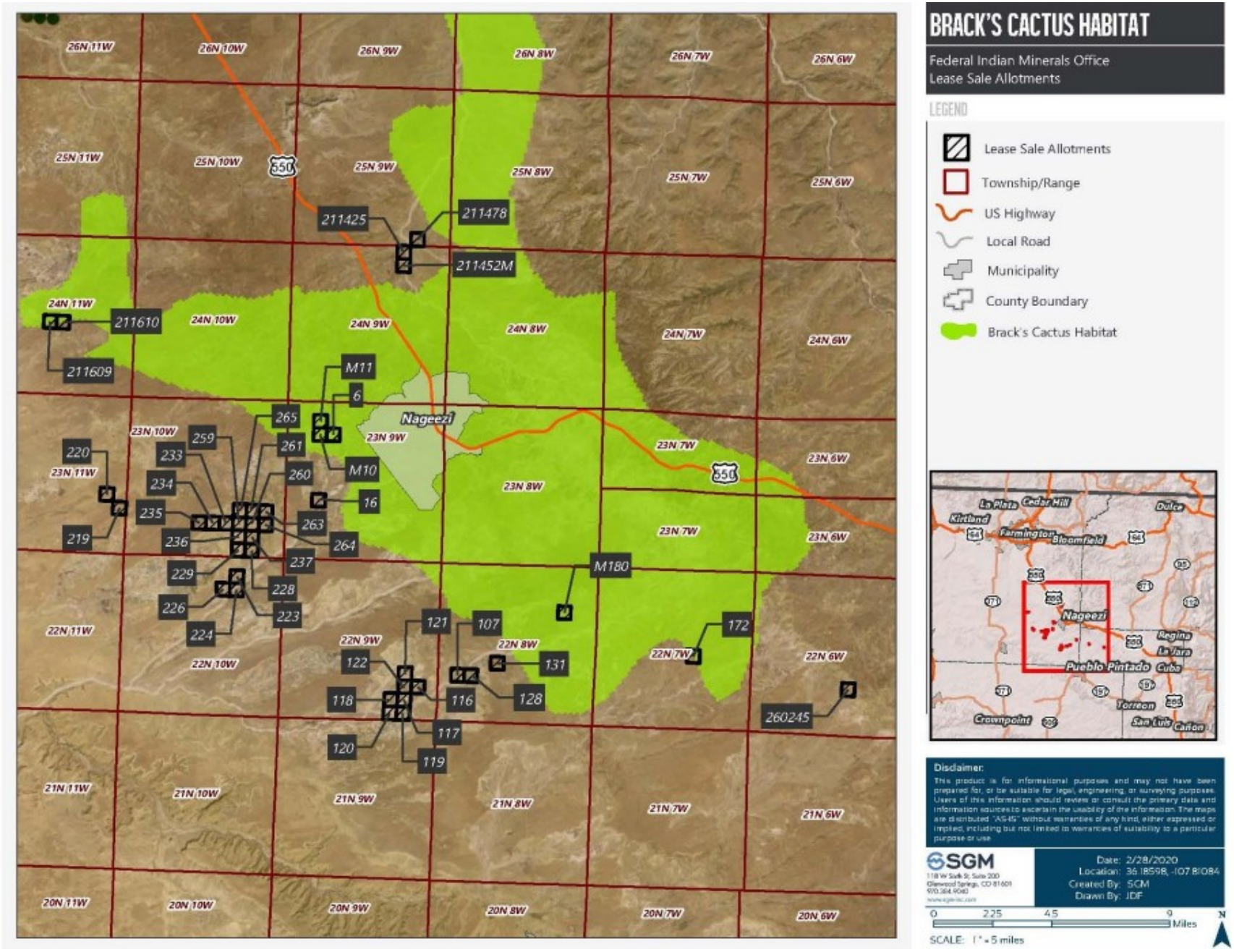


Figure 3.9 Brack's Cactus Habitat



3.13 Visual Resources & Night Skies

3.13.1 Affected Environment

FIMO utilizes the BLM Visual Resource Management (VRM) system for guidance in inventorying and managing visual resources. The primary objective of VRM is to manage visual resources so that the quality of scenic (visual) values is protected. While BLM does not assign VRM classifications to the Indian Allotments, utilizing the VRM classification of adjacent and similar BLM lands provides useful guidance for managing visual resources on the Indian Allotments. As part of the VRM program, the BLM performs a landscape Visual Resource Inventory (VRI) of visual values of all its public lands. The VRI process consists of the following:

- A scenic quality evaluation to rate the visual appeal of an area.
- A sensitivity level analysis to assess public concern of an area's scenic quality and the area's sensitivity to potential changes in the visual setting.
- A delineation of distance zones to indicate the relative visibility of the landscape from primary travel routes or observation points.

Based on these three factors, lands are placed into one of four VRI classes (Class I, Class II, Class III, and Class IV) that represent the relative value of the visual resources and provide the basis for considering visual values in the resource management planning process. VRI Classes II, III, and IV are determined based on a combination of scenic quality, sensitivity level, and distance-zone characteristics to assign the proper class. In the relative scale of visual values, Class II has a higher level of value than Class III, which is moderately valued. Class IV is least valued. VRI Class I is assigned to a special management area where a management decision has previously been made to maintain a natural landscape. These areas are the most valued landscapes. This includes areas such as Wilderness Areas and other congressionally and administratively designated areas where decisions have been made to preserve a natural landscape.

The objective for each VRM Class describes how that area should be managed. FIMO does not assign VRM Classes to FIMO-administered surface, but the forty (40) Indian Allotments included in the Proposed Action are near BLM lands that have been assigned a VRM Class and utilizing the adjacent BLM VRM Class serves as a useful guideline.

The majority of Indian Allotments within the Proposed Action are located within Class III VRM. Five (5) parcels are within Class IV VRM, including Allotments 211425,211452M, 211478, 211609 and 211610. Two parcels: 219 and 220 are in VRM Class II due to the North Road ACEC. Class IV allows for major modifications of the existing visual landscape, while Class III allows for a moderate level of change to the characteristic landscape. Class II allows for only a weak degree of change or contrast.

The area of the Proposed Action is also renowned for dark night skies with minimal light pollution, which creates conditions that are valuable for nocturnal wildlife, recreational astronomers, and stargazers, and as an important component of traditional Navajo beliefs and practices.

Yádiłhił (Navajo word meaning universe or heavens) is very important to Navajo People and is considered a Holy Deity. As a result, every Navajo ceremony incorporates Yádiłhił. Yádiłhił is also a traditional Navajo calendar that identifies the cycle of the Navajo fall, winter, spring, and summer seasons. Navajos track the constellations of the dark skies to determine when certain Navajo activities/ceremonies can be conducted or performed. Dark skies are vital in tracking time and dates and any degradation to dark skies, (especially light pollution) affects major lifeways and ceremonial practices.

The Four Corners region surrounding the Proposed Action Area also has a long history of stargazing, starting with the Ancestral Puebloan culture that inhabited the Chaco area. There has been substantial research in cultural astronomy, and multiple examples where manmade and natural features were used to mark the positions of the sun, moon, and other astronomical phenomena. For the past two decades, Chaco Canyon National Historic Park (CCNHP; located approximately 5 miles south of the Proposed Action) has partnered with the astronomy community. Amateur astronomers regularly host stargazing events under the guidance of a park ranger with an archeoastronomy background. CCNHP is a certified International Dark Sky Park and maintains an inventory of night sky conditions with a monitoring and maintenance program designed to preserve the natural darkness of the Park.

3.13.2 Impacts from the Proposed Action

Direct and Indirect Impacts

There would be no direct impacts to the visual landscape or night sky conditions as a result of leasing the parcels included in the Proposed Action. The leasing action is solely an administrative process and subsequent NEPA analysis and permit approval would be required for future oil and gas development and production activities that may occur as a result of the leasing action.

Indirect impacts include the reasonably foreseeable energy development that is likely to occur on the parcels as a result of the leasing action. Foreseeable development consists of one to two wells per parcel depending on hydrocarbon potential (**Table 2.2** & **Table 2.3**). The well(s) would be co-located on a single well pad and would also include the construction of an access road to the well pad.

The level of disturbance to the visual character of the landscape associated with one well pad per 160 acres is consistent with the VRM guidelines for both Class III and Class IV since the level of change would be moderate. There would be no significant effect to the visual resources of the Allotments if any or all of the individual Allotments were developed as predicted. Further detailed analysis of these potential impacts to the VRI would be analyzed in the future as oil and gas development plans and as permits to drill are submitted. Mitigations and design features in order to reduce the potential impacts to the VRI would be addressed at that time.

The potential indirect impacts to night sky conditions as a result of leasing include the temporary light pollution associated with the construction and drilling components of well pad development. **Table 3.25** lists the light sources associated with drilling an oil and gas well, which are visible from within approximately 5 miles. Sources typically include a light plant or generator, lights on the top of the rig, and vehicle traffic. The number of light sources and the duration of each source are identified. Flaring can be visible at distances of greater than 5 miles; however, flaring typically only occurs in locations where pipelines are not available to transport gas to sale. The necessity for flaring and the duration of flaring varies widely from well to well and is difficult to predict. Flaring is discouraged by the BLM, and APD submissions are typically required to present a mechanism for capturing and transporting gas production to market.

Table 3.25 Light Sources per Well

Light Source			Duration	
Location	***Type***	***Number***	***Days (average)***	***Hours per day***
Foreground/Middle-ground Viewshed (0-5 miles)				
Rig Derrick	4-foot fluorescent	11	3	24
Rig Derrick	Explosion Proof	1	3	24
Light Tower	Explosion Proof	4	3	24
Light Tower	Explosion Proof	2	30	24
Rig Floor	Explosion Proof	2	17	24
Sub	Explosion Proof	4	17	24
Mud Tank	Explosion Proof	9	17	24
Mud Pump	Explosion Proof	6	17	24
Catwalk	Explosion Proof	2	17	24
Tool Shed	4-foot fluorescent	4	17	24
Housing Unit	12-volt	10	17	12

Table 3.25 provides the total number of light sources required during the development of a well. Reasonably foreseeable development includes an average of two wells per allotments, and it is unlikely both wells would be drilled at one time. Therefore, the light impacts described in **Table 3.25** would likely occur on two separate occasions at each well pad and would create a significant increase in light pollution in the surrounding area, impacting the night sky conditions.

Once a well location is completed and enters production, it typically does not have lighting as a permanent feature. Therefore, these artificial lighting and flaring activities are limited to a temporary impact on night sky conditions in the vicinity of the Proposed Action. Note that this impact would largely be confined to a 5-mile radius around the parcels, and CCNHP is at the outer edge of this area of impact, or largely outside of it. Once development is complete, artificial light levels would be substantially similar to existing pre-construction.

3.14 Wildlife and Special Status Species

3.14.1 Affected Environment

Habitats within the parcels included in the Proposed Action, and in the immediately adjacent area, are within the San Juan/Chaco Tablelands and Mesas desert scrub, semi-desert shrub-steppe, and semi-desert grasslands habitat types (Griffith et al. 2006). The characteristic feature of these habitats is co-dominance by various species of shrubs, grasses, and cacti. These habitat types provide cover, forage, breeding, and nesting habitat for a variety of big game and small game species as well as nongame species.

General Wildlife
Various bird, mammal, reptile, and invertebrate species inhabit desert shrubland and grassland ecosystems. Common mammals include desert cottontail, pronghorn, ground squirrels, bats, coyote, gray fox, kangaroo rats, packrats, and other small mammals. Common birds include ravens and horned larks. A wide variety of songbirds and neo-tropical migratory birds also use the region. The vicinity of the Proposed Action contains varying densities of residential and seasonal big game populations.

Migratory Birds
The Migratory Bird Treaty Act (MBTA) of 1918 protects migratory birds and most resident birds that are native to the United States. According to the MBTA, it is illegal to pursue; hunt; take; capture; kill; attempt to take capture or kill; and active nests (and the eggs or young within). The MBTA does not prohibit harassment, disturbance, or habitat removal and alternations. The BLM and FIMO would require project applicants to analyze impacts to migratory birds through the NEPA process and implement BMPs during project-specific applications, including APD submittals.

Federally Listed Species
Section 7 of the ESA requires that federal agencies, in consultation with NNDFW, ensure that their actions are not likely to jeopardize the continued existence of any listed species, or result in adverse effects on designated critical habitat of such species. The ESA also prohibits any action that results in a “taking” of any listed federally protected plant, fish, or wildlife species. The applicant and the BLM and FIMO must ensure that the proposed action does not jeopardize the continued existence of a federally designated critical habitat of a listed species. Compliance with Section 7 of the ESA through the NNDFW will be determined of the project specific level during subsequent NEPA analysis to be completed before implementation of any subsequent oil and gas development or production activities that may occur as a result of leasing actions covered under this EA.

According to NNDFW, two (2) federally listed animal species could possibly occur within the vicinity of the proposed action (**Table 3.26**). However, the allotments included in the Proposed Action do not provide habitat for either species. The Proposed Action area does not contain habitat for any of the thirteen (13) federally listed species occurring in San Juan and Sandoval Counties, the majority of which require aquatic, riparian, or montane habitats that are entirely absent from the Proposed Action area. Upon the receipt of project-specific development applications, the FIMO would conduct biological evaluation, as required under ESA to determine likelihood and presence/absence status of federally listed species and their habitat prior to any future oil and gas development and production activities. Any impact to any federally listed species or their habitat is subject to Section 7 consultation under ESA.

Table 3.26 Threatened and Endangered Species Potentially in Project Area

Species and Status	Distribution in Region	Preferred Habitats	Habitat or Potential Occurrence in Project Area?
BIRDS			
Southwestern willow flycatcher *Empidonax traillii extimus* Endangered	Along larger river and riparian systems.	Riparian habitats near open water with dense shrubby layers	No, suitable habitat within Action Area
MAMMALS			
Black-footed ferret *Mustela nigripes* Experimental population, non-essential	None known to occur	Intermountain and prairie grasslands with abundant prairie dogs	Habitat present; minimal chance of occurrence

According to NNDFW records, the black-footed ferret is known to occur in proximity to Allotment 219. However, this species is extremely rare, and there are no contemporary records of this species occurring within San Juan, Rio Arriba, and Sandoval Counties. Even if the species were to be present, it would likely be considered an experimental non-essential reintroduction population.

Navajo Nation Endangered Species

This section describes animal species included by NNDFW on the Navajo Endangered Species List (NESL) that are not already discussed under the federally listed species. This list is based on existing NNDFW records, and field-based verification has not been conducted. Additional project-specific surveys may be required by the BLM and FIMO prior to project activities in areas potentially supporting use by these species.

Table 3.28 Navajo Nation Special Status Species Potentially in Project Area

Species	Distribution in Region	Preferred Habitats	Potential for Occurrence in Proposed Project Area
BIRDS			
Golden Eagle ***Aquila chrysaetos*** **NESL G3**	**Permanent resident in intermontane grasslands and arid montane habitats**	**Dry, open grasslands**	**Highly likely to occur.**
Burrowing Owl ***Athene cunicularia*** **NESL G4**	**Present seasonally in northern half of New Mexico**	**Grasslands with prairie dog colonies, desert scrub, and in agricultural and semi-urban environments.**	**Highly likely to occur.**
Ferruginous Hawk ***Buteo regalis*** **NESL G3**	**Permanent resident in prairies, deserts, and open habitats**	**Dry, open grasslands**	**Highly likely to occur.**
Mountain Plover ***Charadrius montanus*** **NESL G4**	**Seasonal migrant to breeding sites in prairies and grasslands**	**Dry, open grasslands**	**Highly likely to occur.**
Peregrine Falcon *Falco peregrinus* NESL G4	Occasional migrant or permanent resident in open habitats, preferring cliff habitat and shoreline areas	Cliff zones and sites with concentration of medium-sized bird prey	Possibly occurring
MAMMALS			
Kit fox ***Vulpes macrotis*** **NESL G4**	**Permanent resident in scrub-shrub, desert scrub, and grasslands.**	**Arid scrub-shrub and desert scrub habitats**	**Highly likely to occur.**

3.14.2 Impacts from the Proposed Action

Direct and Indirect Impacts

General Wildlife
The Proposed Action would not directly impact wildlife within the Allotments since no ground-disturbing activities are required as the leasing action is solely an administrative process and subsequent NEPA analysis and permit approval would be required for future oil and gas development and production activities that may occur as a result of the leasing action. Indirect effects from reasonably foreseeable development are difficult to predict but would likely include some minor loss of habitat and habitat fragmentation as a result of well pad construction, as well as increased mortality from vehicle collisions due to increased traffic during development and production.

Migratory Birds
The Proposed Action would not directly impact migratory birds within the Allotments since no ground-disturbing activities are included. The extent of potential indirect effects to birds from the reasonably foreseeable development due to the Proposed Action are difficult to predict. Ongoing studies have shown mixed effects of oil and gas development, including the effect of compressor noise on nesting migratory birds. Impacts to migratory birds would be reduced significantly by the application of BMPs to any development proposal, including common measures such as screened vents, and covered ponds. However, not all impacts would be eliminated. Impacts such as habitat fragmentation and habitat loss would result from well pad construction and would reduce the foraging and breeding habitat available to migratorybirds in the immediate vicinity. The BLM and FIMO would apply BMPs to reduce impacts on migratory birdswith the concurrence from the NNDFW, as a component of the APD review process.

Federally Listed Species
The only federally listed species with the potential to occur in the vicinity of the Proposed Action is the black-footed ferret. However, the ferret is not expected to occur, based on the rarity of the species, the lack of records of occurrence in San Juan County, and the known range of this species being highly restricted and outside of northwestern New Mexico. The Proposed Action would have "*No Effect*" on the black-footed ferret, and there are no existing or proposed Critical Habitats in the vicinity. Although there may be potential habitat for the BFF to occur, no BFF has ever been documented within the action area of this proposed project.

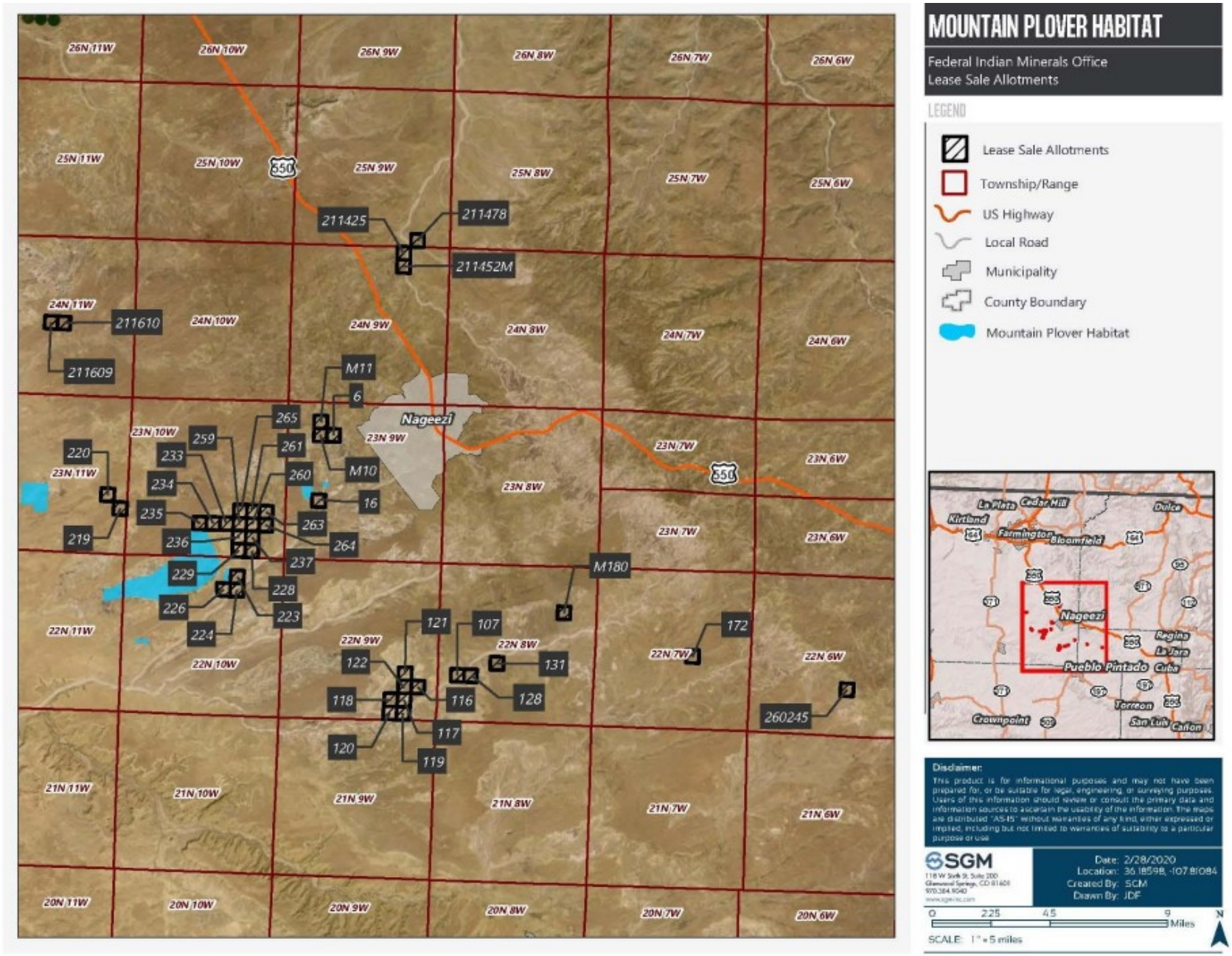
Navajo Nation Endangered Species
The Proposed Action includes areas with the potential to support five (5) bird species and one (1) mammal species included on the NESL (**Table 3.27**). These species are likely, or highly likely to occur, based on the presence of abundant suitable habitat.

The Proposed Action would not directly impact special status animal species within the vicinity of the Proposed Action, since no ground-disturbing activities are required as a component of the leasing action, which is solely an administrative process. Indirect impacts could occur as the result of reasonably foreseeable development activity occurring on the parcels as a result of the leasing action. Subsequent NEPA analysis and permit approval would be required for future oil and gas development and production activities that may occur.

All parcels included in the Proposed Action have the potential to support the animal species included in **Table 3.27** and would need to be evaluated for presence/absence prior to development or surface disturbance. NESL G4 species have no legal protection but reporting observations and documenting them in project planning and management is important to avoid up-listing these species to more protective categories in the future. Lease stipulation BIA-16, prior to site specific ground disturbing activities, biological evaluation (to include survey and assessment of habitat) may be required in areas with potential for NESL G3 species. If NESL G3 species or their habitat are present, development of mitigation plans will be required.

Four (4) parcels including Allotment numbers: **16**, **223**, **224**, and **226** are within known mountain plover habitat areas (**Figure 3.10**) where suitable nesting habitat for the species is known to occur. Two (2) additional Indian Allotments are immediately adjacent to known nesting habitat: **234** and **235**. When ground-disturbing project such as oil and gas development is proposed within mountain plover nesting habitat, the FIMO may attach special management, such as timing stipulations to the APD to mitigate impacts.

Figure 3.10 Mountain Plover Habitat



3.15 Public Health and Safety

3.15.1 Affected Environment

The Proposed Action is in an area with established, widely spaced, oil and gas exploration and development, transportation, and processing operations with accompanying pipelines, compressor and processing facilities, drilling rigs, pumpjacks, traffic, and other related activities. During construction of the projects, physical hazards such as heavy machinery, vehicular traffic, and other typical construction-related activities and hazards would be present. The nominated IA parcels are located in remote areas with limited public visitation in the general vicinity of the communities, Huerfano, Nageezi, Counselor and Lybrook. All nominated IA parcels, with the exception of IA parcel number(s) 172, 211478, 211425, 211452M, 211610, 211609, M180, M10, M11, 6, 15, and 260245, contain residences or have residences within 5 to 10 miles of their respective boundaries. Topics of recent and growing public concern, both nationally and in the decision area, include hydraulic fracturing to enhance the recovery of natural gas and associated liquid hydrocarbons. Another topic of concern is emissions to the atmosphere of natural gas (methane) and other gaseous constituents.

Oil and gas production poses the risk of spills or accidental release of contaminants during the production and transport of natural gas, condensate, and produced water. Companies are responsible for understanding and abiding by all applicable hazardous materials transportation laws and regulations contained in BLM regulation in 49 CFR Parts 100-180 and BIA regulation in 25 CFR 212. There is a potential for a pipeline carrying natural gas, liquid condensate, or produced water to develop leaks or ruptures during natural gas extraction, transport, and processing. Data from the US Department of Transportation indicate that an average of one rupture annually should be expected for every 5,000 miles of pipeline (Office of Pipeline Safety 2005). In addition to pipelines, there is a risk of ruptures of and releases from storage tanks and barrels.

More than 50 percent of pipeline ruptures occur as a result of heavy equipment striking the pipeline. Such ruptures could cause a fire or explosion if a spark or open flame were to ignite the natural gas escaping from the pipeline. Pipeline design, materials, maintenance, and abandonment procedures are required to meet the standards set forth in US Department of Transportation regulations (49 CFR 192, Transportation of Natural Gas by Pipelines). Oil owners and operators are required to maintain and implement spill prevention, control, and countermeasure plans, including cleanup and mitigation measures as required by the BLM or the state.

Public concern about the use of hydraulic fracturing has been focused on the potential for contamination of freshwater aquifers and impacts on domestic and municipal water wells. Seasonal recreation users (e.g., visitors to nearby Special Designations including Wilderness Areas and National Park Service units) may occasionally be within the Project area, although not within the proposed lease parcels.

Physicians and other medical practitioners in Farmington provide medical services to the area. Farmington hospitals provide family health, internal medicine, orthopedic, cardiopulmonary, surgery, radiology, physical therapy, laboratory, and other services. The Dzilth-Na-O-Dith-Hle Indian Health Service Facility (IHS) also provide medical services for local Native Americans. The health center provides ambulatory care to patients, primarily Navajos, living in the Eastern Area of the Navajo Nation.

The all-volunteer San Juan County Fire Department District 11 responds to the Project area. The San Juan County Sheriff's Office provides first-call law enforcement services in the vicinity.

3.15.2 Impacts from the Proposed Action

Direct and Indirect Impacts

There would be no direct impacts to public health and safety as a result of leasing the parcels included in the Proposed Action. The leasing action is solely an administrative process and subsequent NEPA analysis and permit approval would be required for future oil and gas development and production activities that may occur as a result of the leasing action. Public health and safety risks associated with future potential development of the nominated parcels include: occasional fire starts; spills of hazardous materials, hydrocarbons, produced water, or hydraulic fracturing fluids and potential contamination of air, soil, or water; traffic congestion and collisions from commercial vehicles and heavy use; increased levels of fugitive

dust (PM10); infrequent industrial accidents; presence of hydrogen sulfide (H2S); and increased levels of fugitive dust (PM10). .

Indirect impacts include the reasonably foreseeable energy development that is likely to occur on the parcels as a result of the leasing action. Foreseeable development consists of one to two wells per parcel depending on hydrocarbon potential (**Table 2.2** & **Table 2.3**). The well(s) would be co-located on a single well pad and would also include the construction of an access road to the well pad. Some potential risk is inherent in any construction project, and this could include the potential risk of contamination to soil through improper disposal of waste, leaks from equipment, or accidental releases. There is also potential for releases of brine water from the proposed pipeline and tie-in during operation. All well pads, vehicles and other workplaces must comply with worker safety laws as stipulated by the Occupational Safety and Health Administration (OSHA). Developers installing and operating oil and gas wells, facilities, and pipelines wouldbe responsible for complying with the applicable laws and regulations governing hazardous materials and following all hazardous spill response plans and stipulations. The NMOCD requires similar spill response measures after release of hydrocarbons, produced water, or hydraulic fracturing fluids. All lease operations are subject to standard lease terms and conditions as stipulated in 25 CFR 212, the Act of March 3, 1909 and 1982 Indian Mineral Development Act (IMDA).

When significant amounts of chemicals are stored on-site, governmental agencies would be notified as required under the Emergency Planning and Community Right-to-Know Act. The notification of hazardous substance releases outside a facility site is required under the Comprehensive Environmental Response, Compensation, and Liability Act and NMAC 19.15.29. All facilities must have informational signs, as directed under 43 CFR 3160. Risks related to H2S exposure include measures to flare or vent gas and require the use of stock tank vapor recovery systems.

The increase in traffic to area roads and heavy roadside activity during construction could pose a hazard to other vehicles and road users. However, area roads are already used by oil and gas traffic and users would be accustomed to the types of vehicles necessary for construction. The increase in vehicles would be spread across the Project area and drivers would be warned of possible hazards by appropriate signage and would be expected to follow all rules of the road. This impact to area roads would be short term for construction of the Project and would lessen considerably during the operations phase. Vehicular traffic and pipelines are regulated according to safety laws as stipulated by the Department of Transportation.

There are no direct impacts to recreational sites, but recreationalists could be traveling in proximity to the lease parcels. Cautionary signage and other precautionary measures may be necessary to protect recreationists and reduce potential hazards.

Because of the spatially and temporally distributed nature of the reasonably foreseeable development, the indirect impacts to emergency service providers in the region are not expected to be significant. Increased demands potentially could be placed on fire department personnel and equipment but would not dramatically change the fire hazards that currently exist. There is no expected increase in response demands on the San Juan County Sheriff's Office. Federal, state, county and municipal fire managers coordinate on fire response and mitigation.

The Clean Air Act (CAA) requires the U.S. Environmental Protection Agency (EPA) to set NAAQS for pollutants considered harmful to public health and the environment. Primary standards provide public health protection, and secondary standards provide for public welfare, including protection against degraded visibility and damage to animals, crops, vegetation, and buildings (EPA 2019a). The primary NAAQS are set at a level to protect public health, including the health of at-risk populations, with an adequate margin of safety (EPA 2019a).

The National Air Toxics Assessment (NATA), published by the EPA, provides a tool by which to help focus emissions reductions strategies. The most recent NATA was completed for 2014 and was released in August 2018 (EPA 2014b). The 2014 NATA models ambient concentrations and estimates exposures and risk of cancer and/or other health impacts from HAPs, represented as risk hazard indices for cancer, neurological problems, and respiratory problems for each county and census tract (BLM 2019b; EPA 2014b). NATA cannot give precise exposures and risks for a specific individual; therefore, NATA data are best applied to larger areas. NATA derives concentration and risk estimates from emissions data from a single year and assumes a person breathes these emissions each year over a lifetime (approximately 70 years). Lastly, NATA only considers health impacts from breathing air toxics and does not take into account

indoor hazards, contacting or ingesting these air toxics, or other ways in which people may be exposed (BLM 2019b; EPA 2014b). A review of the results of the 2014 NATA shows that cancer, neurological risks, and respiratory risks in the analysis area (San Juan, Sandoval, Rio Arriba, and McKinley Counties) are generally lower than statewide and national levels, as well as those for Bernalillo County, where urban sources are concentrated in the Albuquerque area (EPA 2014b). The 2014 NATA map application reveals that the cancer risk index (defined as the probability of contracting cancer over the course of a lifetime [70 years], assuming continuous exposure) from human-caused emissions of HAPs in most of the analysis area is 6 to 25 (that is, 6 to 25 cases per 1 million people). A smaller area immediately northeast of Farmington in San Juan County and a small portion of south-central Sandoval County (immediately north of Albuquerque) have a slightly higher risk, at 25 to 50 cases per 1 million people (EPA 2014b).

Mitigation Measures

Subsequent NEPA analysis and permit approval would establish necessary protective and mitigation measures, such as appropriately sized valves and water tie-in facilities for anticipated volumes of fluids, operator implementation of safety plans to reduce the risk of spills and accidents, and site security and safety signage.

4. SUPPORTING INFORMATION

4.1 List of Preparers

A draft of this EA was prepared by a third-party contractor according to the direction of FIMO, in cooperation with BLM and BIA staff. The following staff contributed to the final production of this EA:

Name	Area of Expertise	Organization
Robert Begay	Archaeologist	BIA
Chid Murphy	Hydrologist	BIA
Treva Henio	Rangeland Management Specialist	BIA
Laverna Jaquez	Environmental Protection Specialist	BIA
Pamela Kaskela	Fish & Wildlife Biologist	NN
Maureen Joe	FIMO Director	FIMO
Jeffrey Tafoya	Supervisory Natural Resource	BLM
Roger Herrera	Environmental Protection Specialist	BLM
Whitney Thomas	Natural Resource Specialist	BLM
Sharay Dixon	Air Specialist	BLM
Eric Simpson	Archaeologist	BLM
John Kendall	Threatened and Endangered Species Biologist	BLM
Stanley Allison	Outdoor Recreation Planner	BLM
Chris Wenman	Geologist	BLM
Cassandra Gould	Rangeland Management Specialist	BLM
Alexander Nees	Senior Scientist	SGM
Jenna Friesen	Spatial Data Specialist	SGM
Eric Peterson	Senior Scientist	SGM

4.2 Tribal Consultation

Tribal consultation for the proposed leasing action was initiated on a Government-to-Government basis by the FIMO to various Pueblos and Tribes. A letter and map describing the proposed leasing and inviting consultation with the FIMO was sent via certified mail to each of the various Pueblos and Tribes listed below on February 5, 2021, with a request for response within 30 days of receipt.

FIMO received two responses, one from the Hopi Tribe and one from the Navajo Nation. The Hopi Tribe response, dated March 1, 2021, requested, through Section 106, that they be provided with cultural resource inventory reports and to be involved with any treatment plans should an Adverse Effect determination be made. The FIMO response, dated April 13, 2021, explained that Class III cultural resource inventories were not being performed as the leasing would not involve any surface disturbance. The Navajo Nation response, dated February 23, 2021, received via email, and requested additional locational information to aid in the review of the NNHPD TCP database. FIMO responded the same day providing the requested data.

Company	First Name	Last Name	Job Title
Pueblo of Zia	Jerome	Lucero	Governor
Pueblo of Isleta	Vernon	Abeita	Governor
Pueblo of Laguna	John E.	Antonio	Governor
Pueblo of Sandia	Stuart	Paisano	Governor
Pueblo of Ysleta del Sur	E. Michael	Silvas	Governor
Pueblo of Santa Domingo	Sidelio	Tenorio, Sr.	Governor
Ohkay Owingeh	Patrick	Aguino	Governor
Pueblo of Jemez	Michael	Toledo	Governor
Pueblo of San Ildefonso	Christopher	Moquino	Governor
Counselor Chapter, Navajo Nation	Damien	Augustine	President
Navajo Nation	Richard	Begay	Director
Ute Mountain Ute Tribe	Manuel	Heart	Chairman
Pueblo of Cochiti	Joseph	Herrera	Governor
Pueblo of Acoma	Brian	Vallo	Governor
Nageezi Chapter, Navajo Nation	Ervin	Chavez	President
Navajo Nation	Jonathan	Nez	President
Hopi Tribe	Timothy	Nuvangyaoma	Chairman
Pueblo of Picuris	Craig	Quanchello	Governor
Pueblo of Taos	Clyde M.	Romero, Sr.	Governor
Southern Ute Indian Tribe	Melvin	Baker	Chairman
Pueblo of Santa Clara	J. Michael	Chavarria	Governor
Huerfano Chapter, Navajo Nation	Ben	Woody Jr.	President
Pueblo of Pojoaque	Joseph M.	Talachy	Governor
Pueblo of Nambe	Phillip A.	Perez	Governor
Pueblo of Tesuque	Mark	Mitchell	Governor

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APPENDIX A – LEASE STIPULATIONS FOR INDIAN ALLOTMENT LANDS

		Stipulation	Description/Purpose
		BIA-2	Improvements: Notwithstanding the provisions of subparagraph 3 (f), improvements shall be defined for the purposes of this lease as any house, barn or other buildings or structure, any improved land being used for farm or agricultural purposes and any other improvements to the land such as a lake, farm plot, monument, fences, historical etc. Where an "improvement" is present within 200 feet of a proposed oil and gas operations, the lessee, prior to entering the premises to begin any operation whatsoever, shall secure from the lessor (Resident) written consent to conduct such operations. The lessee shall present a plan specifying the exact location and description of the operation that is to take place and shall agree with the lessor as to anticipated damages to any improvements. In case of any dispute as to the amount of damages, the matter may be submitted to arbitration in the field between the lessee and lessor an independent arbitrator to be selected by the two.
		BIA-3	Navajo Grazing rights to the surface of the lands so leased shall be protected, and the lessor's rights respecting - the use of water shall be unimpaired. Compensation as determined by the FIMO will be required for all surface damages. The lessee shall submit a development plan for surface use for the entire leased area to the Federal Indian Minerals Office, 6251 College Blvd, Suite. B, Farmington, NM 87402.
		BIA-4	Compliance with Surface and Environmental Protection Stipulations of the National Environmental Policy Act (NEPA) of 1969. • Notwithstanding any provision of this lease to the contrary, any drilling, construction or other operation on the leased lands that will disturb the surface thereof or otherwise affect the environment (hereinafter called "surface disturbing operation') conducted by lessee shall be subject, as set forth in this stipulation, to the prior approval of such operation by the BLM in consultation with the appropriate surface management agency and to such reasonable conditions as may be required to protect the surface of the leased lands and the environment. • Prior to entry upon the leased land or the disturbance of the surface, the lessee shall submit a development plan for surface use and a full Environmental Assessment for the entire leased area to the Bureau of Indian Affairs (BIA), environmental Quality Officer, Navajo Regional Office, PO Box 1060, Gallup, New Mexico 87305. An analysis will be made of the plan by BIA and the FIMO for purpose of insuring that the surface, natural resources, the environment, and existing improvements are properly protected and timely reclamation of disturbed area. Upon completion of the environmental analysis, the BIA shall notify the lessee of the stipulations and the conditions to which the proposed surface disturbance operations will be subject.
		BIA-5	Prior to commencement of the drilling of a well, the lessee shall have the leased premises surveyed, by a registered land surveyor, boundaries posted with substantial monuments, and a tie established

			with the nearest known United States Public Land. Certified copies of the survey plats must be filed in duplicate with the Bureau of Land Management, Farmington Field District Office, and the Farmington Indian Minerals Office. Failure to comply with this provision shall render the lease subject to cancellation in the discretion of the Secretary of Interior. Permission to drill will be not be granted by BLM prior to compliance with 43 CFR 3164.1. No Adjustments will be made of the bonus money or annual rental due because of differences that may be found in the acreage stated in the lease.
		BIA-11	The Navajo Tribal Historic Preservation Officer (THPO) will be consulted to determine the appropriate avoidance/mitigation strategy for any historic properties located in these corridors.
		BIA-16	Prior to site specific ground disturbing activities, biological evaluation (to include survey and assessment of habitat) may be required in areas with potential for NESL G3 species. If NESL G3 species or their habitat are present, development of mitigation plans will be required.
		BIA-17	Community, residence, and sensitive area of No Surface Occupancy is allowed within 660 feet of any occupied residences of community and sensitive area to reduce impacts to the community, residence, and sensitive areas of oil ang gas activities.

APPENDIX B – TYPICAL PHASES OF OIL & GAS DEVELOPMENT

CONTRUCTION ACIVITIES

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 tack hoes are used to construct, at a minimum, the pad. Other features, as needed for development, may include, but are not limited to, an access road, reserve pit, pipeline, and/or fracturing pond. Cut and fills may be required to level the pad or road surfaces. 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., portion of the pipeline or road right-of-way [ROW]) are reclaimed by recontouring the surface and establishing vegetation.

If a pipeline is needed, the ROW 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 on-site 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 horizontal well to target the desired formation. The depth of the well is entirely dependent on the target formation 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 hold, 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 d rill 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 zone.

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

HYDRAULIC FRACTURING

Hydraulic fracturing is 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 fluid (gas or water) to the wellbore (Groundwater Protection Council 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 (EPA 2004). 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 (EPA 2004). The additional fluids are needed to maintain the downhole pressure necessary to accommodate the increasing length of the 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% 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 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.

Chemicals serve many functions in hydraulic fracturing, from limiting the growth of bacteria to preventing corrosion of the well casing. Chemicals are needed to ensure the hydraulic fracturing jobs is effective and efficient. The fracturing fluids used for shale stimulations consist primarily of water but also include a variety of additives (EPA 2004). 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 three and 12 additive chemicals depending on the characteristics of the water and the shale formation being fractured. Each component serves a specific engineered purpose. 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 slick-water (Groundwater Protection Council 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 (Groundwater Protection Council 2009).

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

Some soils and geologic formations contain low levels of radioactive material. This naturally occurring radioactive material (NORM) emits low levels of radiation, to which everyone is exposed on a daily basis. When NORM is associated with oil and natural gas production, it begins as small amounts of uranium and thorium within the rock. These elements, along with some of their decay elements, notably Radium-226 and Radium-228, can be brought to the surface in drill cuttings and produced water. Radon-222, a gaseous decay element of radium, can come to the surface along with the shale gas. When NORM is brought to the surface, it remains in the rock pieces of 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.

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

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 Field Office 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 the drilling, the BLM is on location during the casing and cementing of the groundwater 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 formations. If the fracturing of the well is considered to be a "non-routine" fracture for the area, the BLM would always be on-site during those operations as well as when abnormal conditions develop during the drilling or completion of a well.

PRODUCTION OPERATIONS

Production equipment used during the life of the well may include a three-phase separator-dehydrator, flowlines; a meter run; tanks for condensate, produced oil, and water, and heater treater. A 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 aboveground structures not subject to safety considerations are painted a standard BLM environmental color or as landowners 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.

Anticipated use or produced hazardous materials during the development may come from drilling materials; cementing and plugging materials; hydraulic fracturing materials; production products (natural gas, condensates, produced water); fuels and lubricants; pipeline materials; combustion emissions; and miscellaneous materials. The table below includes some of the common wastes (hazardous and nonhazardous that are produced during oil and gas development.

Common Wastes Produced during Oil and Gas Development

Phase	Waste	
Construction	Domestic wastes (e.g., food scraps, paper, etc.)	
	Excess construction materials	Woody debris
	Used lubricating oils	Paints
	Solvents	Sewage
	Drilling muds, including additives (i.e., chromate and barite) and cutting 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	Rigwash
	Production testing wastes	Excess drilling chemicals
	Excess construction materials	Processed water
	Scrap metal	Contaminated soil
	Sewage	Domestic wastes
Hydraulic Fracturing	See below	
Production	Power unit and transport maintenance wastes (i.e., batteries, used filters, lubricants, filters, tires, hoses, coolants, antifreeze, paints, solvents, used parts)	
	Discharged produced water	
	Production chemicals	
	Workover wastes (e.g., brines)	
Abandonment/ Reclamation	Construction materials	
	Decommissioned equipment	
	Contaminated soil	

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APPENDIX C – CULTURAL RESOURCE ANALYSIS

Overview of Analysis

The Federal Indian Minerals Office (FIMO) is proposing to offer 40 parcels of Indian Allotment land for fluid mineral leasing. The present study assesses the undertaking's potential to affect historic properties at the leasing stage primarily by means of an existing literature and data review. Site-specific identification efforts, including Class III cultural resources inventories, will occur later, at the APD stage. As part of the records search, data from the New Mexico Cultural Resources Information System (NMCRIS) database and other databases to identify known historic properties and other cultural resources within the project's APE were consulted.

At the leasing stage, existing ethnographic literature and existing data sets were utilized to identify and analyze the potential for impacts to cultural resources other than historic properties already evaluated for NRHP eligibility. In many cases, sites identified through ethnography are managed under E.O. 13007 and NEPA rather than the Section 106 process because they fail to meet the technical definition of historic properties, and/or to maintain details of the sites' locations and functions in greater confidence. These authorities strongly encourage the avoidance or resolution of impacts such that significant impacts are highly unlikely following the conclusion of review and consultation processes, and unmitigated impacts less likely still.

Area of Potential Effects

The Physical APE is defined as a ¼ mile buffer around each parcel, exclusive of areas closed to new surface development, and the Atmospheric APE as a 1- mile buffer around the direct APE. Physical effects have the potential to impact any category of site. In contrast, generally, sites eligible for NRHP listing for reasons other than or in addition to their archaeological data potential (Criterion D), especially those for which setting is an important aspect of integrity, are susceptible to principal types of atmospheric effects such as impacts to their viewshed or soundscape. Such sites may be susceptible to non-physical impacts that undermine the sites' setting or other aspects of integrity, as given at 36 CFR Part 800.5(a)(1). For the purposes of this study, many ethnographically identified sites, sites of known traditional religious and cultural significance, and most Chacoan roads and outliers are assumed to be eligible for NRHP listing under Criteria A, B, and/or C, regardless of a past evaluation to the contrary or a lack of formal evaluation.

Sites of Traditional Religious and Cultural Significance

NHPA as well as various other authorities, most prominently including the American Indian Religious Freedom Act (AIRFA), the Native American Graves Protection and Repatriation Act (NAGPRA), and E. O. 13007, Indian Sacred Sites, mandate the consideration and protection of sites that are key to Native American religious practice or cultural identity. Such locations are generically labeled "properties of traditional religious and cultural significance" by NHPA, a categorization that should be understood to include traditional cultural properties (TCPs) as defined in Federal or tribal regulations, sacred sites, and similar items defined by various other authorities.

Cultural Resource Background

Cultural resources in northwestern New Mexico include Native American archaeologically defined cultures dating from ca. 9500 BC to AD 1450, historic Native American cultures from ca. AD 1450 to present, and European derived cultures from ca. AD 1539 to present. Common or key culture-period attributions for sites in this region include:

Culture	Period	Dates
Paleoindian	(All)	< 9500 BC to 5500 BC
Archaic	Early Archaic	5500 BC to 3000 BC

	Middle Archaic	3000 BC to 1800 BC
	Late Archaic	1800 BC to AD 200
Anasazi (Pecos Classification)	Basketmaker II (BMII)	AD 1 to 500
	Basketmaker III (BMIII)	AD 500 to 700
	Pueblo I (PI)	AD 700 to 900
	Pueblo II (PII)	AD 1100 to 900
	Pueblo III (PIII)	AD 1100 to 1300
Navajo	Pre Pueblo Revolt	< AD 1692
	Post Pueblo Revolt	AD 1692 to 1753
	Pre-Reservation	AD 1753 to 1868
	Early Reservation (to arrival of railroads)	AD 1868 to 1880
	Middle Reservation (to World War I)	AD 1880 to 1920
	Late Reservation (to World War II)	AD 1920 to 1945
	Recent	AD 1945 to date of recording
Hispanic & Anglo/Euro-American	Mexican/Santa Fe Trail	AD 1821 to 1846
	US Territorial	AD 1846 to 1912
	Statehood -- WWII	AD 1912 to 1945
	Recent	AD 1945 to date of recording
Note: Culture-period names and date ranges generally derive from the NMCRIS User's Guide Period and Phase Definitions, published by ARMS.		

Results of the Existing Records Review

Each of the 40 parcels are located on Indian Allotment land and together contain approximately 6,442 acres. The physical APE contains approximately 15,321 acres and includes a mix of surface ownership that includes Indian Allotment, Tribal Trust, Bureau of Land Management, New Mexico State Land Office, and private. The atmospheric APE contains 60,029 acres and extends onto the same land ownership types. The combined direct and indirect APE contains 73,350 acres with 15,230 acres (20%) of that having been inventoried at the Class III level.

A total of 340 historic properties have been identified in the combined APE with 58 of these being the physical APE and the remaining 282 in the atmospheric APE (Table 1). This results in a ratio of one historic property for every 45 acres surveyed (1:45). This site density calculation may over-estimate actual site density due to the predominance of linear inventory corridors over solid block inventory and the resulting "edge effect". It is possible then that total of 1,674 historic properties might be expected to be present within the combined APE.

Of these 340 historic properties, 110 have been determined eligible for inclusion on the National Register with 56 being for Criterion D and the remainder not having a criteria listed. Thirty-five have undetermined eligibilities, 29 have been determined not eligible, and 166 have unknown eligibility (Table 2). A look at the feature types present on the sites allows for some assumptions to be made regarding eligibility for many the of sites lacking details (Table 3). There are 392 components (individual occupations) identified for these historic properties which are broken down by site type in Table 4.

The analysis revealed the presence of multiple Chaco related sites within both the physical APE and atmospheric APE of some of the parcels. Parcel 791 219 is of particular interest as it has the Chaco North Road (segments of which are represented by several sites in Table 1) crossing north-south through its eastern half. The BLM North Road ACEC abuts this parcel on the east, south, and north sides and itself has an No Surface Occupancy (NSO) management prescription for new leases on BLM lands. This same segment of the North Road falls within the atmospheric APE of Parcel 291 220. To understand how potential

future oil and gas development might impact the North Road, a viewshed analysis was conducted. For Parcel 791 219, 99.9% of the physical APE and 70.4% of the atmospheric APE fall within the viewshed of the North Road. For Parcel 791 220, 57.5% of the physical APE and 84.2% of the atmospheric APE fall within the viewshed of the North Road. Given that the North Road is a NR eligible property (Criterion A, C, and D) and that setting is an important element of its significance, it is unlikely then that unmitigated development of Parcel 791 219 would be feasible. Development of Parcel 719 220 is slightly more feasible but with strict placement mitigations measures. These measures might involve, but are not limited to, use of environmental colors, positioning out of the viewshed, and aligning well pad features to produce low contrast.

Another set of Chaco affiliated sites are located in the atmospheric APE of two parcels (791 118 and 791 120). These sites are part of a Chaco Outlier Great House community and part of the Bis Sa'ani Archaeological District (NR and State Register listed property), the BLM Bis Sa'ani ACEC (2003 RMP provides for discretionary closure of new oil and gas leasing and NSO for existing leases) and are designated as a Chaco Protection Site. Parcels 791 117 and 791 119 also have the eastern edge of the ACEC within their atmospheric APEs but not the Archaeological District or Protection Site boundaries. Viewshed analysis similar to what was conducted for the North Road was conducted for the Bi Sa'ani Great House sites. For Parcel 791 118, 89.9% of the physical APE and 71.6% of the atmospheric APE fall within the viewshed of Bis Sa'ani. For Parcel 791 118, 91.3% of the physical APE and 85.4% of the atmospheric APE fall within the viewshed of Bis Sa'ani. Given that the North Road is a NR eligible property (Criterion A, C, and D) and that setting is an important element of its significance, development within these parcels would only be feasible with mitigation measures to reduce the visibility of any development.

Fifty-two Traditional Cultural Properties (TCP) have been identified within the area of analysis (Table 5). Due to the overlapping nature of the APEs, many of these TCPs are associated with multiple parcels. These include 10 that extend between physical and atmospheric APEs, and forty-two only located within atmospheric APEs. These TCPs have all been identified as significant to the Navajo Nation and any development would need to involve consultation with the Navajo Nation Heritage and Historic Preservation Department and local chapters.

Table 1. All Sites

LA #	NMCRIS #	Physical APE Parcel	LA #	NMCRIS #	Physical APE Parcel
9177	64, 125017	NA	18791	4466	NA
9178	64, 125017	NA	18792	4466	NA
9179	64, 125017	NA	18793	4466	NA
14707	125017, 4192, 4466	NA	18794	4466	NA
14710	125017, 4466, 4192	NA	21701	17944	NA
14714	125017, 4192, 4466	NA	21702	17518, 4150	118
14722	4192	NA	25658	5184	NA
14723	4466, 4192	NA	26334	5292	NA
14724	4192, 4466	NA	27619	58, 58781	NA
14725	139481, 4192	NA	28790	4217	NA
14727	4466, 4192	NA	28791	4217	NA
14728	4192, 4466	NA	28793	4217	NA
14729	4466, 4192	NA	28846	4217	NA
15200	4641	NA	28847	4217	NA
15201	4641	NA	28848	4217	NA
15918	4366	NA	28849	4217	NA
16257	8965, 54619, 133397, 56248, 4554, 137617	NA	28850	4217	NA
16719	4644	NA	28851	4217	NA
17286	89226, 66535, 66492, 9996, 60138, 25, 57811	NA	28954	11671, 4217	NA
17287	9996, 60138, 25, 57811	NA	28955	11671, 4217	NA
17288	9996, 57811	NA	28959	11671, 4217	NA
17289	89226, 9996, 23494, 57811	NA	28960	4217	NA
17290	9996, 57811	NA	28961	4217	NA
17292	9996, 60138, 57811	NA	28977	4217	NA
17297	58290, 9996, 57811	NA	28986	4217	131
17301	9996, 60138, 109049, 57811	NA	28987	4217	131
17305	9996, 60138, 57811	NA	28988	4217	131

17316	9996, 57811	NA	28989	4217	NA
17317	9996, 109049	NA	28990	4217	NA
17322	58290, 9996	NA	28991	4217, 140830	NA
17325	9996, 60138	NA	28992	4217	NA
17326	9996	NA	28993	4217	NA
17329	9996, 109049	NA	28994	4217	NA
17344	58290, 9996	NA	28995	4217	NA
17345	9996, 109049	119 & 120	28996	4217	NA
17346	9996, 109049	NA	28997	125017, 11671, 107172, 4217	131
18786	4466	NA	28998	11671, 89439, 4217	131
18787	4466	NA	28999	11671, 4217	131
18788	4466	NA	29000	11671, 4217	NA
18789	4466	NA	29001	11671, 4217	131
18790	4466	NA	29032	4217	NA
LA #	**NMCRIS #**	**Physical APE Parcel**	**LA #**	**NMCRIS #**	**Physical APE Parcel**
29033	4217	NA	34736	70, 11671	NA
29095	4217	NA	34737	70, 11671	NA
29583	6456	NA	34738	70, 11671	NA
29584	6456	NA	34739	70, 11671	NA
30505	4466	NA	34740	70, 11671	NA
30508	4466	NA	34741	70, 11671	219
30522	4466	NA	35507	88	NA
30524	4466	NA	35508	88	NA
30537	6481	NA	35509	88	NA
32565	101	228 & 229	35510	88	211609 & 211610
32566	101	224	35511	88	211609
34276	18702	NA	35512	88	211609
34277	18702	NA	35513	88	NA
34278	18702	NA	35514	88	NA
34279	18702	NA	35515	88	NA
34280	18702	NA	35517	88	NA
34281	18702	NA	35518	88	NA
34282	18702	NA	35519	88	NA
34283	18702	219	35521	88, 113338	211609 & 211610
34284	18702	219	35522	88	NA
34285	18702	NA	35534	88	NA
34286	18702	NA	35535	88	NA
34287	18702	NA	35536	88	NA
34288	18702	NA	35537	88	NA
34289	18702	NA	35539	88	NA
34290	18702	NA	35540	88	NA
34291	18702	NA	35541	88	NA
34292	18702	219	35542	88	NA
34293	18702	219	35543	88	NA
34294	18702	219	35544	88	NA
34295	18702	NA	35546	88, 42333	NA
34296	18702	NA	35547	88	NA
34297	70, 94827, 18702	NA	35548	88	NA
34302	18702	NA	35554	88	NA
34705	70	NA	35555	88, 122826	211610
34707	70	NA	35556	88	211610
34708	70	NA	38951	6339, 35757, 22770, 42153, 6122	NA
34710	70	NA	39089	5702	131
34726	70, 11671	NA	39103	6137	NA
34733	70, 11671	NA	39129	19205, 6137	NA
34734	70, 11671	NA	39130	6137	NA
34735	70, 11671	NA	39189	#N/A	260245
LA #	**NMCRIS #**	**Physical APE Parcel**	**LA #**	**NMCRIS #**	**Physical APE Parcel**
39190	#N/A	NA	64708	19205	NA

45421	6055	NA	64714	19205	121
47150	6339	NA	64715	19205	121
47673	6995, 6993, 7506, 7177, 82356	NA	64813	19358	NA
47680	43035, 4700	NA	64918	19488	223
49296	6835, 46846	NA	64919	19488	NA
49684	#N/A	NA	64920	19488	NA
49699	6163	NA	64921	19488	NA
51667	31619, 7869	NA	64925	19488	107
51668	31619, 7869	261 & 263	64926	19488	107
51669	31619, 7869	263	64927	19488	NA
51942	7869	228, 260, & 264	64928	19488	NA
56213	16114	NA	72445	26332	NA
56214	16114	NA	73512	58749, 26075	NA
57136	17518	NA	74207	26424	NA
58919	17174	NA	76113	55173, 27516	NA
59000	17489	NA	80350	135064, 34458	NA
59685	109910, 17844	NA	84575	7785	211425 & 211452
59686	17844	NA	88027	37367	NA
59687	17844	NA	88623	40649	NA
59688	17844	NA	98270	43035	NA
59689	17844	NA	98273	43035	NA
59690	17844	NA	98275	43035, 52634	NA
59691	17844	NA	98276	43035	172
60768	18528	NA	100245	42835, 91664	NA
60769	18528	128	106061	46846	NA
60770	18528	NA	106075	46846	211425 & 211452
60771	18528	NA	106076	46846	211425 & 211452
60772	18528	NA	106087	46846	NA
60777	18528	NA	106088	46846	NA
60778	18528	M 180	106089	46846	NA
60779	18528	NA	106091	46846	NA
60780	143021, 18528	NA	106092	46846	NA
60781	18528	NA	106117	46864	NA
60782	18528	NA	108754	31600	NA
64701	19205	NA	108755	31600	NA
64702	19205	NA	115766	96628, 54619	NA
64703	19205	NA	115767	96628, 54619	NA
64704	19205	NA	115768	96628, 54619, 124086	NA
64705	19205	NA	115769	96628, 54619	NA

LA #	NMCRIS #	Physical APE Parcel	LA #	NMCRIS #	Physical APE Parcel
115770	96628, 54619	NA	180098	131620	NA
115771	54619, 122467	NA	180099	131620	M 180
117329	56218	NA	180100	131620	M 180
117330	56218	NA	180101	131620	M 180
125550	63120	NA	180102	131620	M 180
132165	73950	NA	180309	131799	NA
135800	78860	NA	180310	131799	NA
135801	78860	NA	180311	131799	NA
137028	79091	NA	180312	131799	NA
137029	79091	NA	181265	132905	211425 & 211452
138113	81278	NA	181668	133328	NA
138114	81278	NA	181669	133328	NA
138115	81278	NA	182711	133831	NA
138116	81278	NA	182723	133853	NA
138117	81278	NA	183189	134132	NA
138118	81278	NA	183190	134132	NA
138119	81278	NA	183191	134132	NA
138591	82268	NA	183436	134387	NA
138962	134387, 82356	NA	183437	134387	NA
146894	91664	NA	183438	134387, 136051	NA
148964	93665	NA	183439	134387	NA
148965	93665	NA	183726	134646, 136920	NA
157243	132905, 107172, 126156	NA	183727	134646, 136920	NA

157244	132905, 107172	NA	183733	134672	NA
157254	125017, 107172	NA	184220	135064	NA
158490	109049	NA	184221	135064	NA
158491	109049	NA	184255	135130	NA
158492	109049	NA	184854	135586	NA
159609	110358	211609	184855	135586	NA
160518	111121, 126656	NA	185606	136051	NA
160519	111121, 126656	NA	185607	136051	NA
163039	113803	131	185608	136051	NA
167380	118249	NA	185660	136063	NA
171643	122467	NA	185661	136063	NA
171645	122467	NA	185662	136063	NA
172779	124086	NA	186655	136920	NA
173650	125017	NA	186656	136920	NA
174614	125438	NA	186786	137088	NA
176089	125017, 142128, 142969, 139223, 137411, 140830, 136679	131	186787	137088	NA
177585	129089	NA	186788	137088	NA
180095	131619	NA	187138	137412	NA
180097	131619	NA	187139	137412	NA
LA #	**NMCRIS #**	**Physical APE Parcel**			
187140	137412	NA			
188334	138721	NA			
188335	138721	NA			
188336	138721	NA			
189554	139223	260245			
189595	139543	NA			
191289	140527	NA			
191494	140830, 140991	NA			
191564	140991	NA			
194660	143563	NA			

Table 2. NRHP Determination Made

	Number of Cultural Resources	Eligible (Criteria)	Not Eligible	Undetermined	Unknown	NR Listed
Physical Effects APE	58	10 (A, C, D) 4 (D)	3	7	34	0
Audio-Visual Effects APE	282	44 (?) 52 (D)	26	28	132	4

Table 3. NRHP Determinations with Assumed Eligibility

	Number of Cultural Resources	Eligible (Criteria)	Not Eligible	Undetermined	Unknown	NR Listed
Physical Effects APE	58	11 (A, C, D) 18 (D)	3	12	14	0
Audio-Visual Effects APE	282	7 (A, C, D) 112 (D)	26	45	92	4

Table 4. Table of Component Types

Culture	Period	Site Type	Total	
			#	%
Archaic	Early	Artifact Scatter	1	0.26%
	Early-Middle	Features and Artifact Scatter	1	0.26%
	Early-Late	Artifact Scatter	1	0.26%

		Features and Artifact Scatter	2	0.51%
	Middle	Artifact Scatter	3	0.77%
		Features and Artifact Scatter	1	0.26%
	Middle-Late	Features and Artifact Scatter	2	0.51%
	Late	Artifact Scatter	3	0.77%
		Features and Artifact Scatter	3	0.77%
	Unspecified Period	Artifact Scatter	8	2.04%
		Features and Artifact Scatter	1	0.26%
Anasazi	Basketmaker II	Unknown	1	0.26%
	Basketmaker II-III	Artifact Scatter	1	0.26%
	Basketmaker II-Pueblo IV	Artifact Scatter	1	0.26%
	Basketmaker III	Residence	1	0.26%
	Basketmaker III-Pueblo I	Features and Artifact Scatter	1	0.26%
	Pueblo I	Artifact Scatter	1	0.26%
	Pueblo II	Artifact Scatter	4	1.02%
		Features and Artifact Scatter	3	0.77%
		North Road Segment	15	3.83%
		Residence	5	1.28%
		Unknown	1	0.26%
	Pueblo II-III	Artifact Scatter	5	1.28%
	Pueblo III	Features and Artifact Scatter	1	0.26%
		Chacoan Outlier (Bis Sa'ani East & West)	2	0.51%
		Multiple Residence	1	0.26%
	Unspecific Period	Artifact Scatter	1	0.26%
		Possible Residence	1	0.26%
Navajo	Pre-Pueblo Revolt	Artifact Scatter	2	0.51%
		Features and Artifact Scatter	2	0.51%
	Pre-Pueblo Revolt to Post-Pueblo Revolt	Artifact Scatter	2	0.51%
	Pre-Pueblo Revolt to Recent Navajo	Ranching/Agricultural	1	0.26%
	Post-Pueblo Revolt	Artifact Scatter	2	0.51%
		Unknown	1	0.26%
	Pre-Reservation	Artifact Scatter	1	0.26%
	Middle Reservation	Artifact Scatter	2	0.51%
		Features and Artifact Scatter	4	1.02%
		Simple Features	2	0.51%
		Single Residence	5	1.28%
		Multiple Residence	4	1.02%
		Unknown	1	0.26%
	Middle Reservation to Late	Features and Artifact Scatter	1	0.26%
		Simple Features	1	0.26%
		Ranching/Agricultural	1	0.26%
		Single Residence	1	0.26%
	Middle Reservation to Recent	Artifact Scatter	2	0.51%
		Features and Artifact Scatter	2	0.51%
		Single Residence	1	0.26%
	Late Reservation	Artifact Scatter	2	0.51%
		Features and Artifact Scatter	6	1.53%
		Simple Features	1	0.26%
		Ranching/Agricultural	3	0.77%
		Single Residence	5	1.28%

		Multiple Residence	2	0.51%
		Ceremonial Location	1	0.26%
		Unknown	1	0.26%
	Late Reservation to Recent	Artifact Scatter	2	0.51%
		Features and Artifact Scatter	1	0.26%
		Ceremonial	2	0.51%
		Ranching/Agricultural	3	0.77%
		Single Residence	6	1.53%
		Multiple Residence	3	0.77%
	Recent	Artifact Scatter	4	1.02%
		Features and Artifact Scatter	23	5.87%
		Simple Features	4	1.02%
		Ranching/Agricultural	9	2.30%
		Burial	1	0.26%
		Ceremonial	1	0.26%
		Single Residence	23	5.87%
		Multiple Residence	5	1.28%
		Road or Trail	1	0.26%
		Unknown	1	0.26%
	Unspecific Period	Artifact Scatter	1	0.26%
		Features and Artifact Scatter	12	3.06%
		Simple Features	4	1.02%
		Single Residence	10	2.55%
		Multiple Residence	4	1.02%
		Ranching/Agricultural	3	0.77%
		Unknown	1	0.26%
Anglo	NM Statehood to WWII	Ranching/Agricultural	1	0.26%
	NM Statehood to Recent	Artifact Scatter	2	0.51%
	Recent Historic	Artifact Scatter	1	0.26%
		Features and Artifact Scatter	2	0.51%
		Simple Features	1	0.26%
		Single Residence	1	0.26%
Pueblo	Historic	Unknown	1	0.26%
Unknown	Unknown	Artifact Scatter	48	12.24%
		Features and Artifact Scatter	11	2.81%
		Simple Features	3	0.77%
		Unknown	20	5.10%
	Prehistoric	Artifact Scatter	11	2.81%
		Features and Artifact Scatter	2	0.51%
	Aboriginal	Artifact Scatter	16	4.08%
		Features and Artifact Scatter	8	2.04%
		Isolated Feature	1	0.26%
	Historic	Artifact Scatter	1	0.26%
		Features and Artifact Scatter	2	0.51%
		Simple Features	1	0.26%
		Ranching/Agricultural	1	0.26%
		Residence	2	0.51%
		Unknown	2	0.51%
TOTAL			**392**	**100%**

Table 5. Traditional Culture Properties

TCP	Parcel	APE		TCP	Parcel	APE
053	107, 128	Atmospheric		K125	121	Atmospheric
074	260245	Physical & Atmospheric		K126	118	Atmospheric
095	219, 220	Atmospheric		PN100	107, 116, 121, 122	Atmospheric
097	118, 120	Atmospheric		PN101	107, 116, 117, 121, 122, 128	Atmospheric
098	118, 120	Atmospheric		PN102	107	Physical & Atmospheric
099	119	Physical & Atmospheric			107, 116, 121, 128, 131	Atmospheric
	116, 117, 118, 120, 122	Atmospheric		PN103	107, 116, 121, 122, 128	Atmospheric
100	107	Physical & Atmospheric		PN104	107, 116, 121, 122, 128	Atmospheric
	116, 117, 119, 121, 122, 128	Atmospheric		PN105	121	Atmospheric
101	107, 116, 121, 122, 128	Atmospheric		PN118	211478	Atmospheric
FID1	107, 128	Atmospheric		PN119	6, 10, 11	Atmospheric
FID17	224, 226	Atmospheric		PN120	259, 260, 261, 263, 264, 265	Atmospheric
FID2	119	Physical & Atmospheric		PN121	259, 260, 261, 263, 264, 265	Atmospheric
	116, 117, 118, 120	Atmospheric		PN126	6, 10, 11	Atmospheric
FID3	228, 237, 264	Atmospheric		PN128	16, 261, 263, 264	Atmospheric
FID4	228, 237, 264	Atmospheric		PN152	6	Atmospheric
FID5	260245	Atmospheric		PN201	172	Physical
FID6	260245	Atmospheric		PN202	172	Atmospheric
FID7	260245	Atmospheric		PN218	172	Atmospheric
FID8	260245	Atmospheric		PN226	172	Atmospheric
FID9	260245	Atmospheric		PN228	172	Atmospheric
FID31	6	Atmospheric		PN242	260245	Atmospheric
K004	219	Physical & Atmospheric		PN226	172	Atmospheric
	220	Atmospheric		PN228	172	Atmospheric
K076	6, 10, 11	Atmospheric		PN242	260245	Atmospheric
K122	118, 120	Atmospheric		PN242	260245	Atmospheric
K124	121, 122	Atmospheric		PN242	260245	Atmospheric
TCP 271	260245, 265, 261, 263, M259, 264, 236, 237, 228, 229, 223, 224, 226, 260	Physical & Atmospheric				
TCP 562	107	Physical & Atmospheric				
TCP 782	219	Physical & Atmospheric				

APPENDIX D – REASONABLE FORESEEABLE DEVELOPMENT SCENARIO

Reasonable Foreseeable Development (RFD) of Parcels to Be Offered at the

Federal Indian Minerals Office Oil and Gas Lease Sale, Farmington Area

Introduction

The subject oil and gas lease sale includes 40 parcels, comprising approximately 6,402 acres, in Rio Arriba and San Juan Counties, New Mexico.

This document will provide a basis for an environmental assessment of likely development impacts within the area of the lease sale.

Historical development

In the recent past, the majority of wells drilled in the San Juan Basin were for development of natural gas. Indeed, the San Juan Basin has been a major contributor of domestic gas production, with more than a trillion cubic feet in annual production. A high percentage of those wells were drilled into the Fruitland Coal formation.

However, despite an emphasis on converting coal-fired electricity generation to gas-fired power plants, which would increase demand, the price of natural gas has experienced a significant decline (Chart 1). The reason for the price decline is attributed to the rapid growth of gas production nationwide due to horizontal drilling and hydraulic fracturing.

With new horizontal well technology, an increasing number of wells are being drilled into oil-bearing horizons. Horizontal drilling allows a greater exposure of a producing horizon to the well bore; hydraulic fracturing increases the permeability and thus permits higher flows of hydrocarbons to the well. The trend toward oil over gas well drilling in the San Juan Basin began around 2013.

In addition, oil and gas operators have begun to apply to the Bureau of Land Management (BLM) for approval of unit agreements (UAs) and communitization agreements (CAs) that would permit coordinated development of the produced hydrocarbons. A high percentage of Federal and Indian (Navajo Nation, Jicarilla Apache Nation and Ute Tribal) wells are being drilled within these agreements. Whereas past CAs allowed the shared development of generally a single well, the BLM has approved 'Super-CAs' which allow the drilling of multiple wells across many sections (square miles) of land by a single operator. Within UAs and 'Super-CAs', spacing is waived and horizontal wells are drilled in the most favorable locations, and with the most favorable direction and length of the horizontal wellbore, to maximize production potential.

Analysis

This document relies heavily upon the RFD prepared by the Farmington Field Office of the BLM for the Mancos-Gallup Resource Management Plan Amendment (RMPA). The Final Report for the RMPA was issued in February, 2018. In essence, the RFD for the December Navajo Nation Oil and Gas lease sale is a subset of the Mancos-Gallup RFD.

The Mancos-Gallup RFD determined the Occurrence Potential for the San Juan Basin.

Copy of Table 2 from the Mancos-Gallup RMPA: Rating system for hydrocarbon occurrence potential.

Occurrence Potential	Explanation
Very High	Within two or more overlapping USGS Assessment Units
High	Within one USGS Assessment Unit
Medium	Outside of USGS Assessment Units, but conditions for hydrocarbon accumulation may exist
None	Intrusive igneous rocks outcrop at surface. Conditions for hydrocarbon accumulation do not exist

Based upon the analysis in the Mancos-Gallup RMPA, the hydrocarbon occurrence potential is very high for all parcels in the subject lease sale.

Copy of Table 3 from the Mancos-Gallup RMPA: Rating system for occurrence potential for horizontally-developed plays.

Occurrence Potential	Explanation
Very High	Within two or more major horizontal plays
High	Within one major horizontal play
Medium	Within no major horizontal plays, but within one or more moderate horizontal plays
Low	Outside of major and moderate horizontal plays
None	Intrusive igneous rocks outcrop at surface. Conditions for hydrocarbon accumulation do not exist

Based upon the analysis in the Mancos-Gallup RMPA, the hydrocarbon occurrence potential for horizontally-developed plays ranges from high to low, with most of the parcels having high or medium potential.

Development potential summary for the December, 2020, Navajo Nation Lease Sale (modified from Figure 10 from the Mancos-Gallup RFD):

Development Potential	Parcels by Category	Acres in Lease Sale	Number of Wells to be Drilled	Type of Development
High	11	1,762	22	Likely Horizontal
Medium	27	4,320	27	Likely Horizontal
Low	2	320	4	Likely Vertical
Total	40	6,402	53	

The forty parcels in this sale are all a minimum of 160 acres, consisting of a quarter-section of land or its equivalent. The Mancos-Gallup horizontal play is being developed using 160 or 320-acre spacing. **Each parcel could support the drilling of at least one horizontal or vertical well. Parcels in the High Potential category may experience <u>two horizontal wells</u> per drill pad.**

The RFD for the Mancos-Gallup play for the Farmington RMPA provided an analysis of current and projected surface disturbance, in Supplemental Tables C and D:

Supplemental Table C. Estimated surface disturbance in 2017 from existing wells.

	Well Count	Pad Count	Roads & Flow Lines per Pad (ac)	After Interim Reclamation (ac.)	Total Acres
Existing horizontal wells (avg. 2 wells/pad)	557	279	0.6	2.5	865
Existing vertical wells	26,517	26,517	0.6	1.5	55,685
Totals	27,074	26,796	---	--	56,550

Supplemental Table D: New surface disturbance over the life of the plan (2018-2037).

	Well Count	Pad Count	Roads & Flow Lines per Pad (ac)	After Interim Reclamation (ac.)	Total Acres
Projected horizontal wells (avg. 2 wells/pad)	2,300	1,150	0.6	6.25	7,878
Projected vertical wells	900	900	0.6	3.75	3,915
Existing horizontal wells (avg. 2 wells/pad)	557	279	0.0	0.25	70
Existing vertical wells	26,517	26,517	0.0	0.25	6,629
Totals	30,274	28,846	---	--	18,492

For the subject lease sale, the following table depicts projected surface disturbance, only for new wells:

	Well Count	Pad Count	Roads & Flow Lines per Pad (ac.)	After Interim Reclamation (ac.)	Total Acres
Projected horizontal wells (avg. 2 wells/pad)	49	38	0.6	6.25	260.3
Projected vertical wells	4	4	0.6	3.75	17.4
Totals	53	42	--	--	**277.7**

Thus, the forecast assumes a total of 53 wells will be drilled; long-term surface disturbance due to the leasing and development of the 40 parcels in the subject sale is 277.7 acres.

Production Forecast

This forecast is essentially a subset of the Farmington Mancos Gallup RFD. That analysis (Supplemental Table B, on page 26 of the RFD) projected a total of 3,200 wells (including 2,400 horizontal and 900 vertical wells) to be drilled within the planning area in the 20-year period that extends from 2018 through 2037. Using the parameters applied in that RFD, the 53 new wells for the subject lease sale are forecast to have production of 4,184,000 barrels of oil; 65,688,000 MCF of gas; and 3,360,000 barrels of water.

References

New Mexico Oil Conservation Division, 2020, information from its GO-TECH online records

U.S. Bureau of Land Management, 2018, Reasonable Foreseeable Development Scenario for Oil and Gas Activities Mancos-Gallup RMPA Planning Area, Farmington Field Office, northwestern New Mexico

U.S. Energy Information Administration, 2020, Henry Hub Natural Gas Spot Price, available at https://www.eia.gov/dnav/pet/pet_pri_spt_s1_a.htm

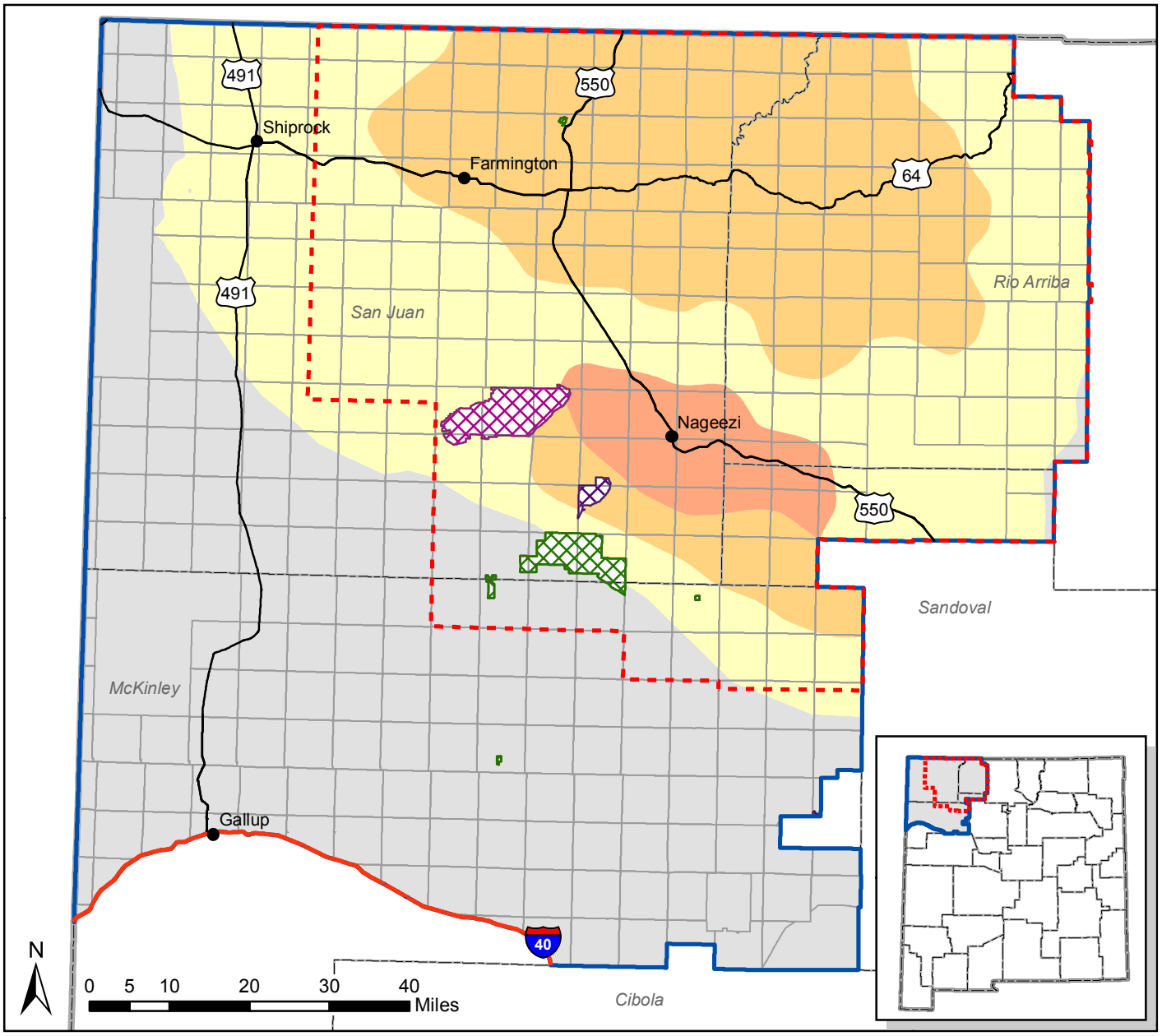
U.S. Energy Information Administration, 2020, U.S. Natural Gas Wellhead Price, available at https://www.eia.gov/dnav/ng/ng_pri_sum_dcu_nus_a.htm

Attachment

1- Page 23 of the Crocker-Glover RFD for the Farmington Mancos Gallup RFD

Figure 10. Oil and Gas Development Potential within the Farmington Field Office Administrative Boundary, 2018-2037

Kelsey Crocker, GIS Specialist
James Glover, Geologist
Farmington Field Office RMPA
February 2018



Development Potential

- Negligible (<1 well per township, likely vertical)
- Low (4-8 wells per township, likely vertical)
- Medium (6-9 wells per township, likely horizontal)
- High (10+ wells per township, likely horizontal)

- RMPA Planning Area
- FFO Admin. Boundary
- National Park Service Boundaries
- Wilderness Areas
- Wilderness Study Areas

NAD 1983 Albers
False Easting: 0.0
False Northing: 0.0
Central Meridian: -106.0
Standard Parallel 1: 33.0
Standard Parallel 2: 36.0
Latitude of Origin: 34.5
Linear Unit: Meter

Areas closed to leasing by statute are not analyzed for development potential.