



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

# Farmington Field Office Oil and Gas Lease Sale, March 2019

Environmental Assessment

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**Location:**

McKinley, Rio Arriba, San Juan, and Sandoval Counties, New Mexico

**U.S. Department of the Interior**

**Bureau of Land Management:**

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## **CHAPTER 1. INTRODUCTION**

### **1.1. Background**

This Environmental Assessment (EA) documents the Bureau of Land Management (BLM) Farmington Field Office (FFO) review of twenty two (22) parcels (7010.82 acres) nominated for auction in the FFO March 2019 Competitive Oil and Gas Lease Sale. Of these twenty two (22) parcels, 1.5 are managed by private surface owners, 18 are managed by Bureau of Indian Affairs (BIA) and 2.5 are managed by BLM. All parcels contain federal minerals. For detailed information of the Leasing Process see the following website: <https://www.blm.gov/programs/energy-and-minerals/oil-and-gas/leasing/parcel-nominations>.

### **1.2. Purpose and Need**

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

### **1.3. Decision to be Made**

The BLM Authorized Officer will decide whether or not to lease the nominated parcels. If the decision is to lease, standard terms and conditions and lease stipulations would apply.

### **1.4. BLM Land Use Plan Conformance and Relationship to Statutes, Regulations, and Other Plans**

#### **1.4.1. BLM Land Use Plan Conformance**

The applicable land use plan (LUP) for the proposed leasing is the 2003 Farmington RMP with Record of Decision (BLM 2003), as amended. One of the goals of 2003 Farmington RMP is to provide opportunities to develop mineral resources (page 2-1). All nominated lease parcels fall within areas designated in the RMP as open under standard terms and conditions. Lease stipulations originating from the 2003 Farmington RMP would apply to each parcel. Additionally, lease stipulations provided by the BIA apply to parcels with surface managed by the BIA. Lease notices and notations also provide information to prospective bidders regarding the following: 1) limitations that already exist in law, lease terms, and regulations, or operational orders; and 2) special items the lessee should consider when planning operations. Further information regarding these items can be found in Appendices A, C, D, and E.

#### **1.4.2. Relationship to Statutes, Regulations, and Other Plans**

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

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

RELEVANT STATUTE, REGULATION OR PLAN	RELATIONSHIP TO THE PROPOSED LEASE SALE
Federal Lands Policy and Management Act (FLPMA)	FLPMA establishes guidelines to provide for the management, protection, development, and enhancement of public lands (Public Law [PL] 94-579). Section 103(e) of FLPMA defines public lands as any lands and interest in lands owned by the United States (U.S.). For split-estate lands where the mineral estate is an interest owned by the U.S., the BLM has no authority over use of the surface by the surface owner; however, the BLM is required to declare how Federal mineral estate is managed in the 2003 Farmington RMP, including identification of all appropriate lease stipulations (43 Code of Federal Regulations [CFR] 3101.1 and 43 CFR 1601.0-7(b); BLM Manual Handbook 1601.09 and 1624-1).
Mineral Leasing Act (MLA)	The MLA establishes that deposits of oil and gas owned by the US are subject to disposition in the form and manner provided by the MLA under the rules and regulations prescribed by the Secretary of the Interior, where consistent with the FLPMA, the NEPA, as amended (PL 91-90, 42 United States Code [USC] 4321 <i>et seq.</i> ), and other applicable laws, regulations, and policies.
43 CFR Part 3100	These regulations govern onshore oil and gas leasing, development and production of Federal minerals.
Federal Onshore Oil and Gas Leasing Reform Act of 1987	This Act directs the BLM to conduct quarterly oil and gas lease sales whenever eligible lands are available for leasing.
New Mexico Surface Owner Protection Act	Of the 22 nominated parcels, parcel 10 contains private surface.  This Act requires operators to provide the surface owner at least five business days' notice prior to initial entry upon the land for activities that do not disturb the surface; and at least 30 days' notice prior to conducting actual oil and gas operations. Included in this policy is the implementation of a Notice to Lessees (NTL), a requirement of lessees and operators of onshore Federal oil and gas leases within the State of New Mexico to provide the BLM with the names and addresses of the surface owners of those lands where the Federal Government is not the surface owner, not including lands where another Federal agency manages the surface.
National Historic Preservation Act of 1966 (NHPA)	Leasing is considered an undertaking under Section 106 of the NHPA. Agencies may follow a phased approach to Section 106 compliance. At the leasing level, existing records reviews and consultation drive identification of historic properties. Class III field inventories are an important part of identification at the APD level. See the text of stipulation WO-NHPA for details.

The Ojo Encino Chapter of the Navajo Nation and the Counselor Chapter of the Navajo Nation develop and maintain land use plans concerning the lands within Chapter boundaries (Ojo Encino Chapter 2016, Counselor Chapter 2002). These land use plans incorporate such items as community assessments, community regional analyses, lands overview, infrastructure analyses, and housing needs. The Ojo Encino Chapter and Counselor Chapter also develop policy positions relating to natural resource development in and surrounding their Chapter boundaries. These policy positions indicate that oil and gas development is not a priority within Chapter boundaries. The nominated lease parcels that fall within these Chapter boundaries are open to leasing of Federal minerals under the 2003 Farmington RMP.

## 1.5. Scoping and Issues

### 1.5.1. Internal Scoping

A BLM FFO interdisciplinary team conducted internal scoping to identify issues, potential alternatives, and data needs by reviewing leasing actions within the context of the existing 2003 Farmington RMP under the NEPA framework. Interdisciplinary team meetings were held on October 4, 2018 and the week of October 15–19, 2018, followed by subsequent meetings with resource specialists to help refine issues related to the proposed lease sale.

### 1.5.2. External Scoping

The March 2019 lease sale schedule was made available to the public on the BLM New Mexico oil and gas lease sales website<sup>1</sup> on October 5, 2019, which included the draft parcel list, spatial data, and exhibits for the proposed lease sale. The BLM NMSO initiated external scoping for the proposed March 2019 lease sale by press release posted on the BLM Information Center website<sup>2</sup> and posted the nominated parcels on line for a 10-day public scoping period from October 8–19, 2018. The project announcement and information was also posted on the [BLM National NEPA Register ePlanning website](#).

During public scoping, the BLM received 21 comment letters opposing the FFO March 2019 Competitive Oil and Gas Lease Sale. The FFO received a more detailed scoping comment letter from two (2) environmental group representing the comments from several other non-profits. Scoping comments received from two (2) pueblos, tribes, Navajo Nation Chapter Houses, or local governmental partners will be addressed through direct dialogue.

Scoping comments received by the FFO in relation to parcels that were within a 10 mile proximity of Chaco Culture National Historic Park. On February 4<sup>th</sup>, 2019, nine (9) parcels totaling 1,482.45 acres, within the Farmington Filed Office have been identified for deferral due to their close proximity to the Chaco Culture National Historic Park. These parcels have been recommended for deferral, and removed from the March 2019 Lease Sale, until such time as the Farmington Resource Management Plan Amendment is complete, to inform leasing decisions in this area. Additionally, no external public scoping comments were received that were in favor of leasing the nominated lease parcels. Concerns and comments presented by the public, as well as environmental groups are summarized in Table 1.3. Similar concerns are grouped together for brevity. Table 1.3 also indicates where external scoping comments are addressed in the EA.

**Table 1.3. Summary of External Scoping Comments and Location in EA.**

SCOPING COMMENT SUMMARY	SECTION(S) OF EA WHERE ADDRESSED
Concerns regarding cultural resources (outside of areas deferred due to proximity to CCNHP).	Section 3.9
Concerns regarding greenhouse gas (GHG) emissions as they relate to climate change.	Section 3.5

<sup>1</sup> <https://www.blm.gov/programs/energy-and-minerals/oil-and-gas/leasing/regional-lease-sales/new-mexico>.

<sup>2</sup> <https://www.blm.gov/press-release/blm-seeks-public-input-proposed-oil-and-gas-lease-sale-parcels-new-mexico-and-oklahoma>.

Concerns regarding the nature and extent of planned government to government consultation.	Section 4.2
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### 1.5.3. 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)). The regulations at 40 CFR 1500.4(g) direct that the scoping process should be used “not only to identify significant environmental issues deserving of study but also to deemphasize insignificant issues narrowing the scope of the [NEPA] process accordingly.”

Issues identified for detailed analysis for the lease sale in this EA are summarized in Table 1.3 and were developed in accordance with CEQ regulations and the guidelines set forth in the BLM NEPA Handbook H-1790-1) (BLM 2008) using input from internal and external scoping. The impact indicators provided are used to describe the affected environment for each issue and measure the amount or degree of change in the issue for different alternatives in Chapter 3 (Affected Environment and Environmental Impacts).

**Table 1.3. Issues Identified for Detailed Analysis at the Lease-Sale Level**

ISSUE	ISSUE STATEMENT	IMPACT INDICATOR
Issue 1	How would emissions of criteria pollutants (respective to the National Ambient Air Quality Standards [NAAQS]) and Volatile Organic Compounds (VOCs) from future potential development of the nominated lease parcels impact air quality?	Emissions (NAAQS, VOCs)
Issue 2	How would future potential development of the nominated lease parcels contribute to greenhouse gas (GHG) emissions?	Emissions (CO <sub>2</sub> e)
Issue 3	How would future potential development of nominated lease parcels 40, 41, and 42 impact the wilderness experience in the Bisti/De-Na-Zin Wilderness?	Acres of disturbance; decibels; visibility (viewshed)
Issue 4	How would future potential development of the nominated lease parcels impact the quality of night skies at the Bisti/De-Na-Zin Wilderness, Ah-shi-sle-pah Wilderness Study Area, and Chaco Culture National Historical Park?	Sky Quality Index (SQI); visibility (viewshed)
Issue 5	How would future potential development of the nominated lease parcels impact groundwater quality and quantity?	Amount of water used and produced; proximity of water features to parcels (wells and springs); depth of water features (wells and springs)
Issue 6	How would future potential development of the nominated lease parcels impact historic properties, including known Traditional Cultural Properties (TCPs)?	Acres of disturbance; visibility (viewshed); audibility (soundscape)
Issue 7	How would future potential development of the nominated lease parcels impact Native American traditional, cultural, and religious concerns?	Acres of disturbance; visibility (viewshed); audibility (soundscape)
Issue 8	How would future potential development of the nominated lease parcels impact environmental justice (EJ) communities and their quality of life?	Impacts of issues analyzed, evaluated as they relate to low-income and minority populations



Twenty-three additional, potential issues were identified. These issues were considered, analyzed in brief and in the light of these assessment were dismissed from further, detailed analysis in Chapter 3. Each of the twenty-three issues are outlined below in Table 1.4 with their corresponding analysis and rationale for not carrying the issue forward for detailed analysis. WO-ESA, WO-NHPA, and NM-11-LN would apply to all nominated lease parcels, as well as standard terms and conditions as described in the lease form.

**Table 1.4. Issues Considered, Analyzed in Brief with Statement of Rationale, and Dismissed from Further Analysis**

ISSUE #	ISSUE STATEMENT WITH CONTEXT DISCUSSION
ELM-1	<p><b>How would future potential development of the nominated lease parcels contribute to the social cost of carbon from greenhouse gas emissions (GHGs)?</b></p> <p>The EA does not undertake an analysis of the social cost of carbon because: 1) it is not engaged in a rulemaking for which the protocol was originally developed; 2) the interagency working group, technical supporting documents, and associated guidance have been withdrawn; 3) NEPA does not require cost-benefit analysis; and 4) the full social benefits of methane and coal-fired energy production have not been monetized, and quantifying only the costs of GHG emissions but not the benefits would yield information that is both potentially inaccurate and not useful. See Appendix G for further explanation.</p>
ELM-2	<p><b>How would future potential development of the nominated lease parcels impact the Old Spanish National Historic Trail (OSNHT)?</b></p> <p>Most parcels are more than 20 miles from the OSNHT. Surface facilities associated with Parcel 10 could occur within 3 to 5 miles of the OSNHT. Approximately 77% of the area of potential effects falls outside the modeled 5-mile OSNHT viewshed. Application of stipulation F-40-CSU would ensure the BLM FFO has the ability to avoid any substantial interference with the nature and purpose of the trail following site-specific analysis for individual development projects.</p>
ELM-3	<p><b>How would future potential development of the nominated lease parcels impact fluid minerals and energy production?</b></p> <p>Depending on the success of oil and gas well drilling, non-renewable natural gas and/or oil would be extracted and delivered to market. Production of oil or gas would result in the irretrievable loss of these resources (i.e., they would no longer be available for future development). The 2003 Farmington RMP committed these resources for oil and gas leasing. Future estimated production from these leases, based on the 2018 RFD (Crocker and Glover 2018), is 2,346,790 barrels (bbl) of oil and 56,737,433 thousand cubic feet (mcf) of gas.</p>
ELM-4	<p><b>How would future potential development of the nominated lease parcels impact forestry and fuelwood resources?</b></p> <p>Parcel 10 contains forested areas including ponderosa pine. Parcels 10, 24, 25, and 38 contain areas of pinyon juniper woodlands. Onshore orders, lease terms, best management practices (BMPs), and site-specific conditions (applied at the APD stage) would help protect fuelwood resources. Voluntary proponent design features and best management practices within the FFO typically provide for trees 3 inches or greater in diameter at ground level to be cut and de-limbed, and either stacked along access roads for wood gatherers or delivered to adjacent Chapter Houses of the Navajo Nation.</p>
ELM-5	<p><b>How would future potential development of on the nominated lease parcels impact fuels and fire management?</b></p> <p>Future potential development of the lease parcels could result in new surface disturbance. Noxious and invasive weeds (including cheatgrass [<i>Bromus tectorum</i>]) readily invade disturbed sites. The potential spread of cheatgrass could provide an opportunity for increased fine fuel loading and an environment conducive to wildland fires. However, as discussed under ELM- 11, the BLM's authority under section six of the standard lease terms and conditions would result in the application of measures to reduce or eliminate the spread of noxious and invasive weeds.</p>
ELM-6	<p><b>How would future potential development of the nominated lease parcels impact the potential for induced seismicity in the San Juan Basin?</b></p> <p>Oil and gas development on the proposed lease parcels would likely increase the amount of produced water that would be injected into the subsurface environment. While induced seismicity has been linked to wastewater injection in various parts of the United States (National Research Council 2013), the San Juan Basin has not been associated with induced seismicity (Weingarten et al. 2015). The 2018 USGS Short-term</p>

	Induced Seismicity Model indicates that the San Juan Basin is in an area of less than a 1% chance of potentially minor-damage ground shaking.
<b>ELM-7</b>	<p><b>How would future potential development of the nominated lease parcels impact lands, access, realty, and the West-wide Energy Corridor?</b></p> <p>Oil and gas leasing is not expected to affect access to public lands because leases are subject to all valid pre-existing rights. Any proposals for future rights-of-ways (ROWs) within lease parcels would be reviewed on a site-specific basis when an application for a ROW is received by the BLM FFO. Off-lease ancillary facilities that cross public land may require separate authorizations. Coordination with the existing ROW holders and application of standard operating procedures, best management practices, and design features at the APD stage, ensure protection of existing rights. Parcel 33 is located on Navajo Nation surface within or adjacent to the nationally designated West-wide Energy Corridor (WWEC). The 2003 Farmington RMP established guidelines for development within the WWEC on BLM managed surface (BLM 2003, pg. 2-11), however there are no WWEC development restrictions on Navajo Nation surface. Any surface disturbance proposed outside of this lease and within the WWEC on BLM managed surface would follow guidelines from the 2003 Farmington RMP which could include siting disturbance outside of the WWEC.</p>
<b>ELM-8</b>	<p><b>How would future potential development of the nominated lease parcels impact the physical and biological integrity of soils?</b></p> <p>The BLM FFO designated fragile soils are located within portions of nominated parcels 16, 26, 38, 39, 42, and 45. Approximately half of nominated parcels 24, 25, and 33 are designated as fragile by the BLM. The aforementioned fragile soils are primarily comprised of the Badland soil type. Badland Rock Outcrop – Persayo Complex is found in parcel 39 and the Vessila – Menefee – Orlie Association soil type is found within parcels 24 and 25. Fragile soil impacts from future potential development of the lease parcels would be analyzed further during the site specific NEPA analysis conducted in conjunction with the APD process. The BLM’s authority under section six of the standard lease terms and conditions would result in the application of measures to mitigate impacts to the physical and biological integrity of soils during the development of a lease.</p>
<b>ELM-9</b>	<p><b>How would future potential development of the nominated lease parcels impact vegetation?</b></p> <p>Future potential development on the nominated lease parcels would introduce new surface disturbance involving vegetation removal. Using land cover data from the Southwest Regional Gap Analysis Project (SWReGAP), the following vegetation types are present on one or more lease parcels: sagebrush shrublands, pinyon/juniper woodlands, badland/rock/wash, and greasewood (SWReGAP 2019). These vegetation communities provide soil cover, wildlife habitat, and livestock forage among other values to varying levels. Lease parcels would follow standard terms and conditions which include interim and final reclamation requirements, and provide the BLM with the authority to determine site specific vegetation management strategy at the APD stage.</p>
<b>ELM-10</b>	<p><b>How would future potential development of the nominated lease parcels impact livestock grazing?</b></p> <p>All nominated lease parcels except 42-46 are within BLM managed allotments; these include the Candelaria, Star Lake Community, Pueblo Pintado Community, Carson-Gallegos Community, Blanco Navajo Community, Counselor Community, Kimbeto Community, Sweetwater, and Petrified Forest grazing allotments. Vegetation communities in these allotments provide livestock forage to varying degrees, with the sagebrush grassland community primarily utilized. Grazing on nominated parcels 11-17 and 40-42 allotments is managed by the Bureau of Indian Affairs Eastern Navajo Agency (BIA-ENA).</p> <p>Future potential development on the nominated lease parcels would introduce new surface disturbance on the aforementioned livestock grazing allotments. This would involve vegetation removal and changes to forage conditions. Alterations to existing range improvements are also possible. The BLM’s authority under standard lease terms and conditions would result in the application of measures to mitigate livestock grazing related impacts.</p>
<b>ELM-11</b>	<p><b>How would future potential development of the nominated lease parcels impact the introduction and/or spread of noxious weeds and invasive plants?</b></p> <p>Future potential development of the nominated lease parcels would introduce new surface disturbance. Invasive and noxious weeds invade disturbed sites, compete with native vegetation, and contribute to the degradation of soil health. In the event noxious weeds are discovered at any time during future potential development, standard terms and conditions provide the BLM with the authority to develop measures to address potential impacts created from noxious weeds and invasive plants. Development of these measures would occur at the APD stage of lease development and would allow for site specific treatments to be identified and implemented.</p>

<p><b>ELM-12</b></p>	<p><b>How would future potential development of the nominated lease parcels impact paleontological resources?</b></p> <p>Most of the lease parcels within the Farmington Field Office administrative area are mapped as Potential Fossil Yield Classification (PYFC) 5. PYFC 5 lands consist of geologic units that predictably produce vertebrate fossils or scientifically significant invertebrate or plant fossils. The geologic units that are of PFYC 5 value include the Fruitland, Kirtland, Nacimiento, and San Jose Formations.</p> <p>Impacts to paleontological resources can be mitigated by standard lease terms under Section 6 of the lease form, which require a lessee to conduct inventories or special studies at the discretion of the lessor (BLM). Site-specific projects that cause surface disturbance in PFYC 4 or 5 areas are required to have a paleontological survey and/or monitoring conducted at the APD stage in accordance with NEPA and FLPMA. For BIA managed lands paleontological resources are addressed through NEPA. Scientifically significant paleontological resources discovered through surveys or monitoring will be collected by a permitted paleontologist and curated at an appropriate repository. If previously identified paleontological localities located in or near APD sites would be protected and avoided. If in the conduct of operations, paleontological resources are uncovered as inadvertent discoveries, the lessee must cease any operations that would result in destruction of the resource and contact the lessor (BLM). Site-specific impacts may be analyzed further under NEPA at the APD-stage when development details are known</p>
<p><b>ELM-13</b></p>	<p><b>How would future potential development of the nominated lease parcels impact dispersed public recreation?</b></p> <p>Future potential development under the Proposed Action would introduce new surface disturbance and related equipment, roads, and structures distributed across the nominated lease parcels. Oil and gas related disturbances have the potential to modify recreation opportunities and the recreation experience primarily as a result of changes in the landscape (viewshed), soundscape (noise), and presence of oil and gas development related activities (construction, traffic, etc.). The FFO contains a total of 7.8 million acres of public and non-public lands. Parcels 37, 38, and 39 are located on approximately 1,442 acres of BLM-managed surface. The remainder of the nominated lease parcels are located on non-BLM managed lands. Disturbance in the above context is unlikely to modify dispersed recreation opportunities or the experience of dispersed recreation because of the limited scale and existing oil and gas development. If necessary, the BLM's authority under standard lease terms and conditions would allow the application of measures to mitigate recreation-related impacts. Impacts to the Bisti/De-Na-Zin Wilderness, Ah-shi-sle-pah Wilderness Study Area, and CCNHP are analyzed in detail in Issues 3 and 4. Site-specific impacts may be analyzed further under NEPA at the APD-stage when development details are known.</p>
<p><b>ELM-14</b></p>	<p><b>How would future potential development of the nominated lease parcels impact travel and travel management?</b></p> <p>Future potential oil and gas lease operations would likely increase short term traffic to existing roads in regions near nominated lease parcels. Well sites, once construction, drilling, and completion have taken place, do not significantly increase travel on an individual basis, in areas where development already exists. A well site can expect one to two trips per week by a lease operator, for the productive life of a well. Leases that are not developed would not increase traffic and are only valid for a period of</p> <p>10 years without production. Development of new roads and infrastructure within nominated lease parcels would be subject to standard lease terms and conditions, Onshore Orders, as well as site specific NEPA analysis in conjunction with the submittal of an APD or master development plan.</p>
<p><b>ELM-15</b></p>	<p><b>How would future potential development of the nominated lease parcels impact public health and safety?</b></p> <p>The nominated lease parcels are generally located in remote areas with limited public visitation in the general vicinity of the communities of Ojo Encino, Nageezi, Counselor, Lindrith, and Huerfano. One or more residences typically exist within a mile of the nominated lease parcels. What appear to be residences or structures are located within lease parcels 11, 14, 17, 24, 25, 33, 37, 40, and 45. Applicable to parcels on BIA-managed surface, lease stipulation BIA-1 designates a 500-foot setback from residences. Setbacks would reduce the risk of impacts to nearby residences and communities relating to drilling and production activities, increased traffic, as well as air and water health and safety impacts. All lease operations are subject to standard lease terms and conditions, as well as 43 CFR 3160 at the APD approval stage. Potential impacts to public health and safety may be analyzed further during project specific NEPA analysis when site-specific development details are known. Refer to section 3.11 for details on how public health and safety relates to EJ communities.</p>
<p><b>ELM-16</b></p>	<p><b>How would future potential development of the nominated lease parcels impact waste including solid and hazardous materials?</b></p>

	<p>Potential future development of the nominated lease parcels would result in the generation of waste, including solid and hazardous materials. Typical wastes associated with oil and gas development include produced water, hydrocarbons, and fracking fluids among others. Ongoing oil and gas activities include the implementation of measures to reduce or eliminate hazards associated with wastes in compliance with solid and hazardous materials laws and regulations (e.g., implementation of Spill Prevention Control and Countermeasure Plans [SPCC], disposal of wastes at approved facilities, etc.). Implementation of these measures would continue associated with all future potential development activities on nominated lease parcels because these measures are required to maintain compliance with the aforementioned laws and regulations.</p>
<b>ELM-17</b>	<p><b>How would future potential development of the nominated lease parcels impact watershed hydrology and surface water quality and quantity?</b></p> <p>Nominated parcels 11-17 are within the Arroyo Chico subbasin; parcels 10, 24, 25, and 37-39 are within the Blanco Canyon subbasin; parcel 25 straddles the Blanco Canyon and Chaco subbasin. Parcels 12, 33, and 40-46 are within the Chaco subbasin. No lease parcels are within 10 miles of the Rio Chama watershed. Future potential development under the Proposed Action could result in new surface disturbance distributed across the nominated lease parcels. The majority of the nominated lease parcels are located in areas with limited surface waters and topographic relief, with likely few water features that would be considered potentially jurisdictional waters of the U.S. subject to regulation by the U.S. Army Corps of Engineers. As a result of the above factors, watershed hydrology and surface waters would be largely outside of any potential development proposed by a future lessee or operator, reducing and greatly eliminating any impacts. In addition, if necessary the BLM's authority under standard lease terms and conditions would result in the application of measures to mitigate surface water quality and quantity related effects at the APD stage.</p> <p>Leasing and future potential development of the nominated lease parcels would result in oil and gas activities including well pad construction, drilling, and completion for an estimated 28 wells. Of these 18 would be horizontal wells that would employ standard industry practices related to well completion (i.e., perforation and hydraulic fracturing). The BLM requires operators to comply with the regulations at 43 CFR 3160. These regulations require oil and gas development to comply with directives in the Onshore Orders and the orders of the Authorized Officer. Onshore Order No. 2 and the regulations at 43 CFR 3162.3-3 provide regulatory requirements for hydraulic fracturing including casing specifications, monitoring and recording, and management of recovered fluids. In addition, the State of New Mexico Oil Conservation Division expressly prohibits pollution of any surface or subsurface fresh water from well completion activities and provides management of hydraulic fracturing operations. Finally, 19.15.16 New Mexico Administrative Code (NMAC) contains minimum casing and cementing standards. Complying with the aforementioned regulations requires producers and regulators to verify the integrity of casing and cement jobs. Casing specifications are designed and submitted to the BLM together with an APD. The BLM independently verifies the casing program, and the installation of the casing and cementing operations are witnessed by certified BLM Petroleum Engineering Technicians.</p>
<b>ELM-18</b>	<p><b>How would future potential development of the nominated lease parcels impact water rights in the San Juan Basin?</b></p> <p>Water is used primarily in the drilling and completion activities associated with the installation of a new oil or gas well. This use is temporary, and in many cases consists of produced waste water, which is not a portion of any water rights associated with the San Juan Basin. Surface water used for the purpose of oil and gas drilling and completion is purchased legally by those who hold water rights in or around the San Juan Basin. The transaction for this water is largely outside the regulatory framework provided the BLM under FLPMA, and is instead handled by the New Mexico Oil Conservation Division as well as the New Mexico Office of the State Engineer. Other uses of freshwater associated with oil and gas development include dust abatement, and reclamation. These uses are fractional (under one percent) in their cumulative draw from surface waters. All other water uses are evaluated at the APD stage in site-specific NEPA analysis and subject to standard lease terms and conditions.</p>
<b>ELM-19</b>	<p><b>How would future potential development of the nominated lease parcels impact threatened and endangered (T&amp;E) species?</b></p> <p>According to the FWS's Information for Planning and Consultation system (IPaC), the nominated lease parcels are not within habitat of any federally listed species. A database query of the Biota Information System of New Mexico (BISON-M) found an absence of federal and state threatened, endangered, and candidate species within the vicinity of the lease sale parcels.</p> <p>Future potential development on the nominated lease parcels could result in new surface disturbance, however, habitat for threatened and endangered species the nominated lease parcels does not occur within or near the nominated lease parcels. Furthermore, no riparian habitat is located within the nominated lease parcels that could impact habitat for yellow-billed cuckoo and the New Mexico meadow jumping mouse.</p>

	<p>Biological evaluations would be conducted at the site-specific project level for any future actions within the lease parcels to determine if impacts to T&amp;E species would occur. Avoidance, minimization, and/or mitigation measures would also be determined at that time. Standard terms and conditions would apply to all parcels, including stipulation F-41-LN which provides notice of the potential requirement of biological surveys prior to surface-disturbing activities. Additionally, stipulation WO-ESA-7 would be applied to all parcels with potential to contain T&amp;E species.</p> <p>A list of all T&amp;E species that may occur within the nominated lease parcels is provided in Appendix H. See Chapter 4 for additional details regarding impacts and consultation related to threatened and endangered species.</p>
<b>ELM-20</b>	<p><b>How would future potential development of the nominated lease parcels impact BLM Sensitive Species?</b></p> <p>Except for the species listed below, no specific BLM Sensitive Species or their habitats are known to occur within the nominated lease parcels (cite IM or SSS list). Under future potential development of these parcels, the following species and their habitat could be disturbed:</p> <p>Brack's cactus (<i>Sclerocactus cloveriae</i> ssp. <i>brackii</i>) potential habitat occurs in parcels 33, 37, 38, and 39. Potential habitat is habitat that has been modeled or assessed through mapping (i.e., GIS) to identify specific substrates (i.e., formation, soil units) and elevation ranges associated with the subject plant species. Future potential development could reasonably be expected to disturb 19.9 of Brack's cactus potential habitat, representing less than 1% of the available habitat in the FFO (totaling 183,970 acres). This amount of surface disturbance would result in a decrease in habitat quality from human presence and loss of vegetation. Following reclamation, these effects would decrease over time.</p> <p>Shared habitat for Western burrowing owl and Gunnison prairie dogs occurs in parcels 38 and 39. Future potential development could reasonably be expected to disturb 8.7 acres (2 well pads at an average pre-reclamation size of 4.35 acres each) of their habitat, representing less than .1% of the available habitat in the FFO. This amount of surface disturbance would result in a decrease in habitat quality from human presence and loss of vegetation which could disturb reproduction or reduce forage. Following reclamation, these effects would decrease over time.</p> <p>Biological evaluations would be conducted at the site-specific project level for any future actions within the lease parcels to determine if impacts to BLM Sensitive Species would occur. Avoidance, minimization, and/or mitigation measures would also be determined at that time. Standard terms and conditions would apply to all parcels, including stipulation F-41-LN which provides notice of the potential requirement of biological surveys prior to surface-disturbing activities. Additionally, stipulation NM-1-LN would be applied to parcels with potential to contain BLM Sensitive Species.</p> <p>A list of all BLM Sensitive Species that may occur within the nominated lease parcels is provided in Appendix H. See Chapter 4 for additional details regarding Endangered Species Act consultation and coordination.</p>
<b>ELM-21</b>	<p><b>How would future potential development of the nominated lease parcels impact migratory birds?</b></p> <p>The nominated lease parcels are within the North American Bird Conservation Initiative (NABCI) Bird Conservation Region (BCR) 16 (Southern Rockies). There are 11 bird species of conservation concern listed for BCR 16 (Partners in Flight 2016). Within a two-mile buffer of nominated lease parcels, USFWS IPaC system did not identify any bird species of conservation concern (USFWS 2018).</p> <p>Surface disturbance from future potential development of nominated lease parcels is estimated to be approximately 161.30 acres. This amount of surface disturbance would result in a decrease in habitat quality from human presence and loss of vegetation. Following reclamation, these effects would decrease over time.</p> <p>If necessary, the BLM's authority under standard lease terms and conditions would result in the application of measures to mitigate effects to migratory birds at the APD stage. Future potential development would follow BLM FFO migratory bird policy which could include development constraints during migration and nesting seasons as well as nest surveys prior to implementation of development activities.</p>
<b>ELM-22</b>	<p><b>How would future potential development of the nominated lease parcels impact wildlife, including game and non-game species?</b></p> <p>The FFO contains populations of big game species including deer and elk, as well as a multitude of other non-game species. Activities directly and indirectly related to potential oil and gas development of the nominated lease parcels have the potential to impact wildlife. These impacts include loss of suitable forage, loss of suitable habitat, habitat fragmentation, and avoidance of infrastructure. The nominated parcels, with the exception of parcel 10, contain marginal to poor quality wildlife habitat. Parcel 10 acts as a migration corridor, stopover area, and general use area for big game species and contains 160 acres of wildlife habitat within Game</p>

	Management Unit 5A. Any activity that involves surface disturbance or direct resource impacts would be subject to standard lease terms and conditions which allow moving well locations up to 200 meters to address resource concerns.
<b>ELM-23</b>	<p><b>How would the visual landscape be affected by future potential development of the nominated lease parcels?</b></p> <p>The FFO reviewed aerial photography and records of existing oil and gas development to determine if new development would have a significant visual impact. The landscape of some of the nominated parcels do not include existing oil and gas well pads, and the remainder contain 1-2 visible well pads per parcel. Similarly some of the parcels do not contain human-made structures visible on the landscape, and others contain some human-made structures such as homes, fences, and electrical infrastructure. In general, the significance of a new visual element relates to its proximity to a sensitive viewpoint such as residences, with the impact lessening the further away it is from that sensitive viewpoint. Impacts to visual resources from potential future development would be mitigated through application of the F-8-VRM stipulation on the leases. Lease terms and conditions #6 allows the BLM to consider further mitigation for visual resources at the APD-permit stage. The Proposed Action is consistent with VRM Class IV on BLM-managed surface on parcels 37, 38, and 39. Visual resource impacts related to Wilderness, WSAs, and the CCNHP are captured in Issue 4. Visual resource impacts related to adjacent residents and surrounding communities are captured in Issue 8.</p>
<b>ELM-24</b>	<p><b>What are the potential impacts from oil and gas leasing and future potential development on Socioeconomics?</b></p> <p>The oil and gas industry has been a substantial contributor to the social setting and economic basis of the San Juan Basin for decades. While the act of leasing Federal minerals itself would result in no direct social impacts, including impacts to environmental justice populations of concern, subsequent development of a lease may generate impacts to communities and individuals in the vicinity of the lease. At the lease sale stage, it is unknown where, or even if, development will occur in any given lease parcel. As specific types and locations of development are proposed, their impacts will be analyzed and addressed during the APD stage of development. Potential impacts could include impacts to employment opportunities related to the oil and gas and service support industries in the region, as well as impacts to State and County governments related to royalty payments and severance taxes.</p>

## CHAPTER 2. ALTERNATIVES

### 2.1. Alternative A – Proposed Action

Under the Proposed Action, the BLM would offer for lease 22 nominated parcels of Federal minerals administered by the BLM FFO. The nominated lease parcels are generally located within or near the Eastern boundary of the Navajo Nation in an area known as the “checkerboard” because of mixed land ownership. Parcel 10 is near the eastern boundary of the FFO that is predominantly privately owned and abuts the Jicarilla Apache Tribe to the south. The parcels nominated for leasing under the Proposed Action are summarized in Appendix A with their associated lease stipulations. Maps of the nominated lease parcels are provided in Appendix B. Descriptions of lease stipulations are provided in Appendix C.

The nominated lease parcels occur in areas of low, medium, and high development potential as determined by Crocker and Glover (2018). Well densities delineated for each of these development potential categories were used to calculate future potential development on the nominated lease parcels. For parcels where this method resulted in fractional values of less than one well per parcel (because of small parcel acreages and low anticipated well densities), the fractional values were rounded up to one well per parcel to provide meaningful inputs to the oil, natural gas, and water production projections.

Oil and natural gas resources within the nominated lease parcels could be developed within multiple formations, including the Fruitland coal, Pictured Cliffs, Mesa Verde, Mancos, Gallup, and Dakota. Wells could be drilled horizontally or vertically. Estimates of future potential development, as well as oil, natural gas, and water production volumes that could reasonably occur on these parcels were derived from Crocker and Glover (2018). Estimated ultimate recovery of oil, natural gas, and produced water, based on the type of well and geologic formation, are listed in Table 2.1. The estimated number of wells and associated oil, natural gas, and water production for the nominated lease parcels as well as estimated

surface disturbance from future potential development on a parcel-by-parcel basis is provided in Table 2.2.

**Table 2.1. Estimated Ultimate Recoveries of Oil, Natural Gas, and Produced Water by Formation**

WELLBORE DIRECTION	GEOLOGIC FORMATION	OIL PRODUCTION (BBL)	GAS PRODUCTION (MCF)	PRODUCED WATER PRODUCTION (BBL)
Vertical	Generalized	19,115	3,234,964	140,382
Horizontal	Mancos	125,678	1,244,285	69,537

**Table 2.2. Estimated Well Count and Production for the Nominated Lease Parcels.**

PARCEL NO. (ACRES)	VERTICAL WELLS	HORIZONTAL WELLS	TOTAL WELLS ON PARCEL	ESTIMATED SURFACE DISTURBANCE (ACRES)	OIL PRODUCTION (BBL)	GAS PRODUCTION (MCF)	PRODUCED WATER PRODUCTION (BBL)
10 (160)	1	0	1	4.35	19,115	3,234,964	140,382
11 (160)	0	1	1	6.85	125,678	1,244,285	69,537
12 (160)	0	1	1	6.85	125,678	1,244,285	69,537
13 (160)	0	1	1	6.85	125,678	1,244,285	69,537
14 (160)	0	1	1	6.85	125,678	1,244,285	69,537
15 (30)	0	1	1	6.85	125,678	1,244,285	69,537
16 (161.8)	0	1	1	6.85	125,678	1,244,285	69,537
17 (160)	0	1	1	6.85	125,678	1,244,285	69,537
24 (640)	0	4	4	27.4	502,712	1,244,285	69,537
25 (640)	0	4	4	27.4	502,712	4,977,138	278,150
26 (40)	0	1	1	6.85	125,678	4,977,138	278,150
33 (160)	0	1	1	6.85	125,678	1,244,285	69,537
37 (160)	1	0	1	4.35	19,115	3,234,964	140,382
38 (320)	1	0	1	4.35	19,115	3,234,964	140,382
39 (1122.85)	1	0	1	4.35	19,115	3,234,964	140,382
40 (80)	1	0	1	4.35	19,115	3,234,964	140,382
41 (160)	1	0	1	4.35	19,115	3,234,964	140,382
42 (240)	1	0	1	4.35	19,115	3,234,964	140,382
43 (709.29)	1	0	1	4.35	19,115	3,234,964	140,382
44 (712.28)	1	0	1	4.35	19,115	3,234,964	140,382
45 (714.6)	1	0	1	4.35	19,115	3,234,964	140,382
46 (160)	1	0	1	4.35	19,115	3,234,964	140,382
<b>TOTAL (7010.82)</b>	<b>11</b>	<b>17</b>	<b>28</b>	<b>161.30</b>	<b>2,346,791</b>	<b>56,737,440</b>	<b>2,726,338</b>

It is unknown when, where, or to what extent any subsequent well sites, roads, and associated infrastructure would be proposed in the event the BLM decides to lease the nominated parcels. Future

potential development of the nominated lease parcels under the Proposed Action could include the following phases (Appendix D provides a summary of the phases of oil and gas development):

- Well pad construction;
- drilling of a well using a conventional pit system or closed-loop system;
- hydraulically fracturing a well;
- potential flaring of gas;
- construction of new access roads or expansion of existing roads;
- installation of pipeline;
- production, including vehicle traffic, hauling of produced fluids like oil or produced water, compression to move gas through pipeline systems, potential venting from storage tanks, regularly well monitoring, and work-over tasks for the life of the well; and
- well plugging and abandonment/reclamation.

Based on recent oil and gas development in the FFO, the BLM estimates 6.85 acres of surface disturbance for new horizontal wells, containing two wells on one pad, and their corresponding access road and pipeline, and 4.35 acres for new vertical wells and their corresponding access road and pipeline (Crocker and Glover 2018). Assuming future potential development of 11 vertical wells and 17 horizontal wells, approximately 161.30 total acres of new surface disturbance is anticipated (see Table 2.2).

The drilling of wells on parcels leased by BLM is not permitted until the leaseholder submits, and the BLM approves, a complete Application for Permit to Drill (APD) package (Form 3160-3) following the requirements specified under Onshore Oil and Gas Orders listed in 43 CFR 3162. APD approvals are subject to additional environmental review under NEPA. Under the authority granted in Standard Term and Conditions Section 6 attached to each lease, measures to reduce or avoid resource impacts specific to a particular APD are attached as conditions of approval (COA).

## **2.2. Alternative B – No Action Alternative**

Under the No Action Alternative, the BLM FFO would not offer the nominated parcels for competitive leasing in the FFO March 2019 Competitive Oil and Gas Lease Sale (March 28, 2019). As a result, there would be no future potential development related to this analysis on the nominated parcels. The BLM would continue to manage this mineral estate under current management practices. Parcels would have the potential to be nominated again in a future oil and gas lease sale.

## **CHAPTER 3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS**

### **3.1. Introduction**

This section describes the existing conditions relevant to the issues presented in Table 1.3 and discloses the potential direct, indirect, and cumulative impacts of the alternatives on those issues. Cumulative actions incorporated into the analysis are described in Section 3.2, Cumulative Actions. This discussion precedes the issue analysis because past and present actions within the spatial and temporal scale of the issues analysis are components of the affected environment. Likewise, reasonably foreseeable future actions (RFFAs) are enumerated here because they contribute to the cumulative impacts analyses for each issue below.

### **3.2. Cumulative Actions**

As defined in 40 CFR 1508.7 (CEQ regulations for implementing NEPA), a cumulative impact is an impact on the environment that results from the incremental impact of the action when combined with the



effects of past, present, and RFFAs, regardless of which agency (Federal or non-Federal) or person undertakes such other actions.

Table 3.1 provides the spatial scale of analysis for the issues and summarizes past, present, and RFFAs considered in each issue’s cumulative effects analysis. The temporal scale of cumulative impacts analysis for all issues is approximately 20 years into the future. This temporal scope was chosen because it is an approximation of the lifetime of a well and the predictability of RFFAs beyond 20 years.

**Table 3.1 Spatial Scale and Cumulative Actions Associated with Each Issue**

ISSUE	SPATIAL SCALE	PAST & PRESENT ACTIONS	RFFAS
<b>Issue 1</b>	San Juan, Sandoval, Rio Arriba, and McKinley Counties	Emissions from existing sources	Proposed complete shutdown of the San Juan Generating Station Projected emissions as predicted in regional studies: <ul style="list-style-type: none"> <li>● CCARMMS Study</li> <li>● Air Technical Report</li> <li>● RFD 2018</li> </ul>
<b>Issue 2</b>	New Mexico and U.S.	GHG emissions from all existing sources	Continuation of ongoing activities contributing to GHG emissions
<b>Issue 3</b>	Viewshed to the north from the north ridge of the Bisti	<ul style="list-style-type: none"> <li>● Coal mining</li> <li>● Oil and gas development, including all forms of production equipment.</li> <li>● Increased infrastructure such as transmission lines</li> <li>● Highway 371 and other access roads</li> </ul>	<ul style="list-style-type: none"> <li>● Oil and gas development</li> <li>● On-going reclamation</li> </ul>
<b>Issue 4</b>	Dark skies at Bisti, WSA, and CCNHP	Light from all existing sources: <ul style="list-style-type: none"> <li>● Oil and gas development</li> <li>● Communities</li> </ul>	Contribution of light from: <ul style="list-style-type: none"> <li>● Oil and gas development</li> <li>● Community and urban growth</li> </ul>
<b>Issue 5</b>	Confined aquifers: Ojo Alamo Sandstone, Kirtland Shale/Fruitland Formation, Pictured Cliffs Sandstone, Cliff House Sandstone, Menefee Formation, Point Lookout Sandstone, Gallup Sandstone, Dakota Sandstone, Morrison Formation, and Entrada Sandstone	<ul style="list-style-type: none"> <li>● Coal and uranium mining</li> <li>● Oil and gas development, including reuse of produced water</li> <li>● Agricultural production</li> <li>● Domestic and municipal use</li> </ul>	Same as Past and Present Actions
<b>Issue 6</b>	<ul style="list-style-type: none"> <li>● ¼-mile buffer of lease parcels (direct APE)</li> <li>● 1-mile buffer of direct APE (indirect APE)</li> <li>● Viewshed to 15 miles (indirect)</li> </ul>	<ul style="list-style-type: none"> <li>● Grazing</li> <li>● Oil and gas development, including all forms of production equipment.</li> </ul>	<ul style="list-style-type: none"> <li>● Oil and gas development</li> <li>● Community and urban growth</li> <li>● On-going reclamation</li> <li>● WVEC</li> </ul>

ISSUE	SPATIAL SCALE	PAST & PRESENT ACTIONS	RFFAS
		<ul style="list-style-type: none"> <li>● Increased infrastructure such as transmission lines</li> <li>● Highway 371 and other access roads</li> <li>Residential development</li> </ul>	
<b>Issue 7</b>	Same as Issue 6	See Issues 4 and 6	See Issues 4 and 6
<b>Issue 8</b>	Parcel 10 and the Chapter Houses containing all other lease parcels	<ul style="list-style-type: none"> <li>● Grazing</li> <li>● Coal and uranium mining</li> <li>● Oil and gas development</li> </ul>	Oil and gas development

Because of its prominence in the analysis of each issue, additional details regarding past, present, and reasonably foreseeable future oil and gas development are provided below.

The San Juan Basin has been a producing oil and natural gas field since the early to middle 1900s. According to available GIS data, approximately 37,000 wells have been drilled within the boundary of the FFO. Approximately 67% of these wells are gas wells, 6% are oil wells, and 26% are wells that have been plugged and abandoned with reclamation work performed. Vertical natural gas wells have been the dominant drilling activity in the FFO; however, recent drilling has dropped, with the majority of new wells being horizontal oil wells. Crocker and Glover (2018) developed a reasonably foreseeable development (RFD) scenario that estimated existing long-term surface disturbance from oil and gas activities to be 56,500 acres across the FFO. Surface disturbance after interim reclamation was estimated at 3.1 acres for existing horizontal wells (twinned) and 2.1 acres for existing vertical wells (Crocker and Glover 2018). The original disturbance area associated with each well type prior to reclamation was 6.85 acres for horizontal wells and 4.35 acres for vertical wells, and approximately 55 percent of surface disturbance was reclaimed following interim reclamation.

Table 3.2 summarizes development potential using the 2018 RFD scenario (Crocker and Glover 2018). A previous RFD scenario was developed in 2014 for the FFO (Engler et al. 2014).

**Table 3.2. Summary of Development Potential Predicted in the 2018 RFD Scenario (Crocker and Glover 2018).**

DEVELOPMENT POTENTIAL	ACRES IN 2018 RFD SCENARIO	WELLS PER TOWNSHIP	TYPE OF DEVELOPMENT
Negligible	249,400	<1	Likely vertical
Low	1,810,000	4-8	Likely vertical
Medium	1,635,000	6-9	Likely horizontal
High	273,000	10+	Likely horizontal

The 2018 RFD scenario projects 3,200 new oil and gas wells would be drilled within the FFO in the next 20 years (2018-2037), the majority of which (2,300) are predicted to be horizontally drilled. New surface disturbance from potential wells in this scenario is estimated at approximately 18,500 acres. New surface disturbance was estimated at 6.85 acres for future horizontal wells (twinned) and 4.35 acres for future vertical wells (RFD, 2018).

Nominated lease parcels 10, 33, 37-39, 42, 44, and 45 have had previous oil and gas development; wells drilled on these lease parcels have been plugged and abandoned and reclamation is in various stages of completeness. The Cluster Federal #001 well, located on nominated lease parcel 37, has recently been reclaimed and does not yet have BLM approval for final abandonment.

### **3.3. Impacts of Alternative B – No Action Alternative for all Issues**

A separate analysis for each issue analyzed in detail in this EA for Alternative B (the No Action Alternative) is not provided. Under the No Action Alternative the BLM would not lease the nominated 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 on leased land surrounding the nominated lease parcels. No natural gas or crude oil from the nominated lease parcels would be produced, and no royalties would accrue to Federal or State treasuries. Employment and revenue opportunities in local communities related to the oil and gas and service support industry could be lowered under this alternative.

### **3.4. Issue 1: How would emissions of criteria air pollutants (especially volatile organic compounds (VOCs) and nitrogen oxides (NO<sub>x</sub>) and ultimately ozone (O<sub>3</sub>)) from future potential development of nominated lease parcels impact air quality?**

Air quality is determined by the quantity and chemistry of atmospheric pollutants in consideration of meteorological factors (i.e., weather patterns) and topography, both of which influence the dispersion and concentration of those pollutants. The presence of air pollutants is due to a number of different and widespread sources of emissions. The analysis area for impacts to 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 is generally provided at the county level.

#### **3.4.1. Affected Environment**

The Clean Air Act (CAA) requires the EPA to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. *Primary standards* provide public health protection and *secondary standards* provide for public welfare including protection against degraded visibility and damage to animals, crops, vegetation, and buildings (EPA 2016a). 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 2018a).

The EPA has set NAAQS for six principal pollutants (“criteria” air pollutants): carbon monoxide (CO); nitrogen dioxide (NO<sub>2</sub>); ozone (O<sub>3</sub>); particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>); sulfur dioxide (SO<sub>2</sub>); and lead (Pb). 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 (SIP), 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 tribal lands and lands within Bernalillo County.<sup>3</sup> The New Mexico Environment Department (NMED) Air Quality Bureau is responsible for implementation of the SIP and enforcement of air quality standards.

Ground-level ozone (O<sub>3</sub>) is a criteria pollutant that is of most concern for the analysis area. As a secondary formation pollutant, O<sub>3</sub> is not a direct emission (that is, it is not emitted directly into the air), but is the result of chemical reactions between a group of highly reactive gasses called nitrogen oxides

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<sup>3</sup> Under the CAA and the Tribal Authority Rule, Tribes have express authority to manage air quality on tribal lands. Air quality in Bernalillo County is regulated by the City of Albuquerque/Bernalillo Air Quality Division.

(NO<sub>x</sub>) and volatile organic compounds (VOCs, which are organic compounds that vaporize [i.e., become a gas] at room temperature) when exposed to sunlight (EPA 2018d). Because O<sub>3</sub> is not a direct emission, emissions of NO<sub>x</sub> (particularly NO<sub>2</sub>, which is used as an indicator for the larger group of gasses) and VOCs are used as a proxy for determining potential levels of secondary formation of ground-level O<sub>3</sub>. NO<sub>x</sub> can also react with other chemicals in the air to form particulate matter, contributing to haze (EPA 2016b). Major sources of emission for both NO<sub>x</sub> and VOCs include industrial facilities like power plants and motor vehicle exhaust (including off-road equipment). 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 products (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, the emissions are generally controlled with the use of enclosed combustion devices (ECDs), 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 (EPA 2017a). NO<sub>x</sub> are primarily emitted through fossil fuel combustion in electric utilities, high-temperature operations at other industrial sources, and the operation of motor vehicles (EPA 2014a).

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<sup>4</sup> under the CAA are considered to be 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 2018b; NMED 2018a). While O<sub>3</sub> and NO<sub>2</sub> are criteria air pollutants (and therefore regulated under the NAAQS and NMAAQs), VOCs are not.

#### Criteria Pollutant Concentrations

Concentrations of air pollutants are measured at air monitor sites and expressed in parts per million (ppm), parts per billion (ppb), or micrograms per cubic meter (µg/m<sup>3</sup>) 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 2017a).

Design Values are statistics that describes the air quality in a certain area relative to the NAAQS, they are to be consistent with NAAQS as defined in 40 CFR part 50. Design Values are generally used to classify and designate non-attainment areas (EPA 2017b). 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 (Appendix D to 40 CFR Part 58).<sup>5</sup>

Where criteria pollutants are measured at the *regional* scale, the dimension area of measurement ranges from 50 km (approximately 31 miles) up to hundreds of km (also hundreds of miles). Regional siting scales are established for monitoring sites that assess general ambient background levels as well as

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<sup>4</sup> 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.

<sup>5</sup> Appendix D to Part 58 is available at <https://www.gpo.gov/fdsys/pkg/CFR-2014-title40-vol6/pdf/CFR-2014-title40-vol6-part58-appD.pdf>.

welfare-related impacts and encompass rural areas of reasonably homogeneous geography without large sources of criteria pollutants. Smaller *neighborhood* scales are more localized from 500 m (approximately 1,640 feet) out to 4 km (approximately 2.5 miles), which are typically population-oriented sites and may be used to assess source impacts and monitor those areas with the highest concentrations of criteria pollutants. Neighborhood scales generally account for concentrations within some extended area of a city that has relatively uniform land use (EPA 2008a).

There are three active regional air monitors in the analysis area, including two in San Juan County and one in Rio Arriba County.<sup>6</sup> The two monitors in San Juan County are in Chaco Canyon 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<sub>3</sub> and NO<sub>2</sub>. The 1H Substation is operated as part of the state air quality monitoring network overseen by the NMED and measures regional levels of O<sub>3</sub>, NO<sub>2</sub>, SO<sub>2</sub>, and (recently) PM<sub>10</sub>. 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<sub>3</sub> (EPA 2018c). None of the active neighborhood monitors in San Juan and Sandoval Counties have measurement areas that overlap the nominated parcels. Current data for active regional air monitors are used to establish background concentrations of criteria pollutants in the analysis area.

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 parts-per-million (ppm) averaged over an 8-hour period. This standard is met when the fourth-highest daily maximum (for the 8-hour O<sub>3</sub> concentration) is less than or equal to 0.070 ppm when averaged over a 3-year period. The primary 1-hour standard for NO<sub>2</sub> 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 3.3 summarizes the most recent concentrations of criteria pollutants that are monitored at the regional level within the analysis area in comparison to the NAAQS and NMAAQS. The counties in the analysis area do not currently monitor for CO (carbon monoxide), Pb (lead), or PM<sub>2.5</sub>; however, because the counties are relatively rural in character, it is likely that these pollutants are not elevated.

**Table 3.3. Design Values for Counties within the FFO (USEPA 2018b)**

POLLUTANT	2017 DESIGN CONCENTRATIONS	AVERAGING TIME	NAAQS	<sup>6,7</sup> NMAAQS
O <sub>3</sub>	Rio Arriba County: 0.065 ppm Sandoval County: 0.065 ppm San Juan County: 2 stations at 0.064 ppm, 1 station at 0.068 ppm	8-hour	<sup>1</sup> 0.070 ppm	-
NO <sub>2</sub>	San Juan County: 1 station at 10 ppb, 1 station at 6 ppb, and 1 station at 1 ppb	Annual	<sup>2</sup> 53 ppb <sup>2</sup>	50 ppb

<sup>6</sup> Three other active air monitors are located in the northern half of San Juan County, but do not measure at the regional scale. The site at 423 Highway 539 at the Navajo Dam is operated by the NMED to monitor O<sub>3</sub> and NO<sub>2</sub> (at the *middle scale* between 100–500 m). A second site (1ZB) north of Bloomfield is also operated by the NMED to monitor O<sub>3</sub>, NO<sub>2</sub>, and SO<sub>2</sub> (neighborhood scale, 500 m up to 4 km). Lastly, the air monitor site at Diné College in Shiprock, New Mexico on the Navajo Nation is a tribal monitor that measures O<sub>3</sub> and NO<sub>2</sub>; however, no scale is noted in the AirData Air Quality Monitor metadata). Additionally, there is one active neighborhood O<sub>3</sub> monitor on the Sandia Pueblo in southern Sandoval County, located in a more urbanized area north of Albuquerque. There are currently no active air monitors in McKinley County.

NO <sub>2</sub>	San Juan County: 35 ppb	1-hour	<sup>3</sup> 100 ppb	-
SO <sub>2</sub>	San Juan County: 2 ppb	1-hour	<sup>5</sup> 75 ppb	-
PM <sub>2.5</sub>	San Juan County: <sup>3,4,6</sup> 4.1 µg/m	Annual	<sup>3,4,6</sup> 0 µg/m	-
PM <sub>2.5</sub>	San Juan County: <sup>3,4,6</sup> 4.1 µg/m	24-hour	<sup>3,6</sup> 35 µg/m	-
<sup>1</sup> Annual fourth highest daily maximum 8-hour concentration, averaged over 3 years <sup>2</sup> Not to be exceeded during the year <sup>3</sup> 98 <sup>th</sup> percentile, averaged over 3 years <sup>4</sup> Annual mean, average over 3 years <sup>5</sup> 99 <sup>th</sup> percentile of 1-hour daily maximum concentrations, averaged over 3 years <sup>6</sup> The last 3 year average was from 2013-2015 <sup>7</sup> The NMAAQs standard for TSP, which was used as a comparison to PM <sub>10</sub> and PM <sub>2.5</sub> was repealed as of November 30, 2018				

Breathing ground-level O<sub>3</sub> can have human health effects particularly for sensitive groups (children, the elderly, and those with chronic lung conditions like bronchitis, emphysema and asthma) as well as sensitive vegetation (NMED 2018b). Ground-level O<sub>3</sub> 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 2018d). Biogenic sources, such as trees and plants, can represent a substantial portion of NO<sub>x</sub> and VOC emissions in an area, including New Mexico (BLM 2017a).

Monitoring conducted by the NMED (under the EPA) in the analysis area indicates that levels of O<sub>3</sub> 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 2018c). New Mexico Environment Department-Air Quality Bureau (NMED-AQB) has begun developing an Ozone Attainment Initiative (OAI) that if implemented on schedule will have a plan in place by summer of 2020. The OAI plan will set standards for emission sources that contribute to the exceedance of design values of 95% or more, in particular to control NO<sub>x</sub> and VOCs to achieve maintenance or attainment of the standards pursuant to New Mexico Statute 74-2-5.3 (NMED-AQB 2017a).

Particulate matter (also known as particle pollution) is a mixture of solid particles and liquid droplets in the air. Particulate matter varies in size; however, the EPA is most concerned about particulate matter 10 micrometers in diameter or smaller because they are inhalable into the lungs (NMED 2018b). PM<sub>10</sub> refers to particulate matter 10 micrometers or less in diameter (commonly considered “dust”). PM<sub>2.5</sub> 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 U.S. (EPA 2018e). The EPA regulates inhalable particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>) but does not regulate particles larger than 10 micrometers in diameter (such as sand and larger dust particles).

There is one recently inactive neighborhood monitor for PM<sub>2.5</sub> (fine particulate matter) in the analysis area located at the NMED office in Farmington (with a last sample date of December 29, 2015). It is assumed that operation of this monitor was discontinued after 2015 with approval from the EPA because

the affecting sources had been shut down. Other air monitors for PM<sub>2.5</sub> in the analysis area that are currently inactive went out of operation more than 10 years ago. None of the inactive monitors measured regional PM<sub>2.5</sub> levels, but did so at the neighborhood scale. PM<sub>2.5</sub> 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<sub>10</sub> (dust) in the analysis area began in 2017 at the 1H Substation. Like ground-level O<sub>3</sub>, most particulate matter is formed by reactions between other chemicals, specifically between SO<sub>2</sub> and NO<sub>x</sub>, which are emitted from vehicles, power plants, and other industrial processes (EPA 2018e).

Particulate matter emissions often result from activities like construction, traffic on unpaved roads, fields, and wildfires (EPA 2018e). Particulate matter is of heightened concern when emissions are near sensitive receptors, such as residences, because particulate matter can be present in higher concentrations in a localized area prior to settling or dispersion.

### 3.4.1.1 *Criteria Pollutants 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 2017a). Total human caused emissions within the analysis area are reported in Table 3.4 based on 2014 NEI in tons per year (EPA 2018f).

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 2018f). The primary source of several criteria air pollutants in the analysis area are two coal-fired electrical generation units (EGUs): the San Juan Generation Station 15 miles west of Farmington, New Mexico and the Four Corners Power Plant on the Navajo Nation near Fruitland, New Mexico. These EGUs are the primary source of SO<sub>2</sub> (85%), NO<sub>x</sub> (41%), and PM<sub>2.5</sub> (3%) in the analysis area (BLM 2017a; EPA 2018f).

**Table 3.4. Current Human-Caused Emissions Estimates in the Analysis Area (Tons/Year) 2014 National Emissions Inventory (NEI) Data**

COUNTY	NO <sub>x</sub>	CO	VOCs	PM <sub>10</sub>	PM <sub>2.5</sub>	SO <sub>2</sub>
San Juan	41,650	83,443	47,768	40,270	7,519	5,450
Sandoval	5,117	25,830	7,308	22,571	3,266	175
Rio Arriba	12,992	43,196	35,352	18,658	3,671	153
McKinley	10,496	14,465	3,335	37,226	4,443	824
<b>Total</b>	<b>70,255</b>	<b>166,934</b>	<b>93,763</b>	<b>118,725</b>	<b>18,899</b>	<b>6,602</b>

Source: EPA (2018f).

Note: Values include Tier 1 summaries for each county including combustion, industrial, onroad/nonroad, and miscellaneous sectors. Biogenic sources are not included.

### 3.4.1.2 *Air Quality Index*

The level of emission for a pollutant, in consideration of weather and geographical influences, is a key factor affecting the concentration of that pollutant in an area. Emissions, which contribute to concentrations, can be understood through the Air Quality Index (AQI). 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: ground-level O<sub>3</sub>, particulate matter

(PM2.5 and PM10), NO2, SO2, and CO (all except Pb). According to the EPA, ground-level O3 and particulate matter, both calculated daily for the AQI, are the two air pollutants that pose the greatest threat to human health. (AirNow 2016).

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 they 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 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 3.5 presents the AQI values (with associated color category) and levels of health concern.

**Table 3.5. The Air Quality Index (AQI)**

<b>AQI VALUES</b>	<b>LEVELS OF HEALTH CONCERN</b>	<b>MEANING</b>
0 to 50 (Green)	Good	Air quality is considered satisfactory, and air pollution poses little or no risk.
51 to 100 (Yellow)	Moderate	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
101 to 150 (Orange)	Unhealthy for Sensitive Groups	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
151 to 200 (Red)	Unhealthy	Everyone may begin to experience health effects and members of sensitive groups may experience more than serious health effects.
201 to 300 (Purple)	Very Unhealthy	Health alert: everyone may experience more serious health effects.
301 to 500 (Maroon)	Hazardous	Health warnings of emergency conditions. The entire population is more likely to be affected.

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

The AirData AQI Summary Report (EPA 2018f) provides annual summary information, including maximum AQI values and the count of days in each AQI category. Table 3.6 provides a summary of the number of days classified above 100 (unhealthy for sensitive groups or worse) for the counties in the analysis area for the period from 2006 to 2017.

**Table 3.6. AQI Summary Data for Number of Days Classified above 100 for the Analysis Area (2006–2017)**

<b>COUNTY</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>
<b>San Juan</b>	24 <sup>1</sup>	45	3	0	20 <sup>2</sup>	18	12	6 <sup>3</sup>	0	2	2	6
<b>Sandoval</b>	17	6	0	0	0	0	0	0	0	0	0	1
<b>Rio Arriba</b>	0	0	0	0	0	0	0	2	0	0	0	3
<b>McKinley</b>	–	–	0	0	0	0	0	0	–	–	–	–

Source: EPA 2018g.

Note: All AQI values presented are classified as *unhealthy for sensitive groups* (101–150), unless otherwise indicated. Annual summary data for McKinley County is only available for 2008–2013. Annual statistics for 2018 will not be available until May 1, 2019.

<sup>1</sup> Including one (1) *unhealthy* day (above 150).

<sup>2</sup> Including five (5) *unhealthy* days (above 150) and two (2) *very unhealthy* days (above 200).

<sup>3</sup> Including one (1) *unhealthy* day (above 150).



For the reporting period, San Juan County had the most incidences of the number of days classified above 100 annually, including 9 days reaching *unhealthy* (7 days above 150) to *very unhealthy* (2 days above 200) for everyone. These days occurred in 2006 (1 unhealthy day), 2010 (5 unhealthy days and 2 very unhealthy days), and 2013 (1 unhealthy day). While there are exceedances of NAAQS on those days with AQI values over 100, these exceedances do not represent a trend of degrading AQI values over time as indicated by Table 3.6 above.

#### 3.4.1.3 Hazardous Air Pollutants (HAPs)

The CAA requires control measures for hazardous air pollutants (also known as HAPs), 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 emissions standards for HAPs (NEHAPs) established by the EPA limit the release of specified HAPs from specific industries (BLM 2017a; EPA 2017a). NEHAPs for oil and gas development include control of benzene, toluene, ethyl benzene, mixed xylenes and n-hexane from major sources, and benzene emissions from triethylene glycol dehydration units as area sources (BLM 2017a). The CAA defines a major source for HAPs as being one that emits 10 tons/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 2017a). In New Mexico, regulations for major sources are found under 20.2.70 and 20.2.71 New Mexico Administrative Code.

The National Scale 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 2018h). 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 and respiratory problems for each county and census tract (BLM 2017a; EPA 2018h and 2018i). NATA cannot give precise exposures and risks for a specific individual, therefore, NATA data is 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 that people may be exposed (BLM 2017a; EPA 2018h).

A review of the results of the 2014 NATA shows that cancer, neurological, 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 2018h). 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 6–25 (that is, 6–25 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 slightly higher risk at 25–50 cases per 1 million people (EPA 2018j).

#### 3.4.2. Environmental Consequences

Methodology and assumptions for calculating air pollutant emissions and developing inputs for the calculators are described in the Air Resources Technical Report (BLM 2017a:31–37). 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 will 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 2017a).

#### 3.4.2.1. *Impacts of the Proposed Action*

Future potential development of the nominated lease parcels would include increased criteria pollutant emissions, including increased particulate matter released from new well pads or roads, exhaust emissions from drilling equipment, compressor engines, vehicles, flares, and dehydration and separation facilities, and VOCs during drilling and production activities. As stated above, the most substantial criteria pollutants emitted by oil and gas development and production are VOCs, particulate matter, and NO<sub>2</sub>.

Future potential development on the nominated lease parcels is estimated at approximately 17 horizontal and 11 vertical wells across all nominated lease parcels (see Table 2.2 for a listing of the number of wells anticipated per parcel and whether or not they would be horizontal or vertical wells). To facilitate quantification, this analysis assumes that all parcels would be developed concurrently, though it is more likely that future potential development would occur over a period of years.

Under the Proposed Action, future potential development of the nominated lease parcels would result in an incremental addition of criteria pollutants and VOCs to the atmosphere in the analysis area. To analyze emissions for the Proposed Action, values in this table are multiplied by 17 and 11 for horizontal wells and vertical wells, respectively (see Table 2.2, Section 2.1 above). Tables 3.7 and 3.8 shows estimated emissions generated from one proposed horizontal oil well and one proposed horizontal gas well for criteria pollutants and VOCs, as well as the overall percent change in emissions from current estimates (see Table 3.9 in Section 3.1.2.1 above).

Emissions under the Proposed Action are anticipated to be at the most acute level during the construction and completion phases of implementation (approximately 25 days in duration) because these phases require the highest degree of earth moving activity, heavy-equipment use, and truck traffic compared to the operations and maintenance phases of implementation. Emissions are anticipated to decline during operations and maintenance as the need for earth moving and heavy equipment declines. 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 because the addition of criteria pollutants and VOCs would equate to less than a 0.5% increase in overall emission levels. Because the increase in overall emission levels would be low (<0.5%), future potential development of the nominated lease parcels would not be expected to increase the number of days classified above 100 (unhealthy for sensitive groups, or worse) and therefore it is not anticipated that the Proposed Action would result in a change in the AQI for the analysis area.

Emissions for a one-well horizontal and oil gas well on federal lands are included in Tables 3.7 and 3.8. Emissions for vertical wells were omitted from this analysis due to current predominant technological drilling methods being horizontal. Additionally, presenting 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 SO<sub>2</sub> which could be 4-5x greater in a vertical well scenario however sulfur dioxide emissions are still estimated to be within the same magnitude and less <1 ton per year of SO<sub>2</sub> emissions per well.

**Table 3.7. Emissions Estimates for One Horizontal Oil Well**

Activity/ Phase	Annual Emissions (Tons) <sup>1</sup>						
	PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>x</sub>	SO <sub>2</sub>	CO	VOC	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	14.94	1.18
Maintenance	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<sup>2</sup> Reclamation	0.00	0.00	0.18	0.00	0.08	0.00	0.00
<b>Total</b>	<b>5.31</b>	<b>0.81</b>	<b>6.19</b>	<b>0.11</b>	<b>2.63</b>	<b>15.36</b>	<b>1.60</b>

<sup>1</sup> Values where a “0.00” appear may be too small and not appear due to rounding.

<sup>2</sup>Reclamation PM<sub>10</sub> emissions were estimated to be twice the value of Maintenance PM<sub>10</sub> values.

**Table 3.8. Emissions Estimates for One Horizontal Gas Well**

Activity/Phase	Annual Emissions (Tons) <sup>1</sup>						
	PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>x</sub>	SO <sub>2</sub>	CO	VOC	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
<sup>2</sup> Reclamation	0.00	0.00	0.18	0.00	0.08	0.00	0.00
<b>Total</b>	<b>0.92</b>	<b>0.49</b>	<b>5.71</b>	<b>0.11</b>	<b>1.95</b>	<b>0.77</b>	<b>0.59</b>

<sup>1</sup> Values where a “0.00” appear may be too small and not appear due to rounding.

<sup>2</sup>Reclamation PM<sub>10</sub> emissions were estimated to be twice the value of Maintenance PM<sub>10</sub> values.

**Table 3.9 Percent Increase from Future Potential Development of the Lease**

	Percent Increase of Emissions due to the Lease Sale					
	PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>x</sub>	SO <sub>2</sub>	CO	VOC
Current Emissions	118,725	18,899	70,255	6,602	166,934	93,763
One well Emissions <sup>1</sup>	5.31	0.81	6.19	0.11	2.63	15.63
Total Emissions from Lease Sale (28 Wells)	148.68	22.68	173.32	3.08	73.64	437.64
<b>Percent Increase</b>	<b>0.13</b>	<b>0.12</b>	<b>0.25</b>	<b>0.05</b>	<b>0.04</b>	<b>0.5</b>

<sup>1</sup> Emissions from one horizontal oil well was used to determine the percent increase of emissions all the potential future development for this lease sale.

Emission estimates for a construction, operations, maintenance and reclamation are included. 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 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. 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.

VOCs and NO<sub>2</sub> contribute to the formation of ground-level O<sub>3</sub>, which is the pollutant of most concern in northwestern New Mexico and because O<sub>3</sub> is not a direct emission, emissions of NO<sub>x</sub> and VOCs are used as a proxy for estimating O<sub>3</sub> levels. Under the Proposed Action, the additional NO<sub>2</sub> and VOCs emitted from any oil and gas development on these specific leases (as quantified in Table 3.7 and 3.8 for oil and gas wells respectively above) are anticipated to be too small in quantity to result in exceedances of ground-level O<sub>3</sub> in the analysis area.

For many processes it is assumed that emission of HAPs will be equivalent to 10% of VOC emissions. Therefore, the estimated HAP emissions of 1.25 tons/year should be considered a very gross estimate. Most of the VOC emissions estimated for one horizontal oil well result from venting from oil storage tanks. Current EPA regulations require operators to reduce VOC emissions by 95% if their oil storage tanks emit over 6 tons of VOC emissions per year. A reduction of 95% of oil storage tank VOC emissions would reduce the estimated HAP emissions to 0.12 tons/year.

Under the Proposed Action, one of the primary sources of particulate matter emissions would be from construction of potential future development of the nominated 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<sub>2.5</sub> (fine particles) can travel farther in terms of distance than PM<sub>10</sub> (dust) and other total suspended particulates (TSP, particles of sizes up to 50 µm) and therefore can impact local residents in the surrounding area (Araújo et al. 2014).

While impacts to air quality on a broad-scale in the analysis area would be small, the Proposed Action would result in localized impacts to air quality for nearby residences from emissions of particulate matter, VOCs, and HAPs. In the absence of precipitation, PM<sub>2.5</sub> can travel great distances (thousands of km) can remain in the atmosphere for several days, while PM<sub>10</sub> (and larger) settles within hours of being released into the atmosphere and is generally dispersed over much shorter distances (i.e., closer to the source) due to larger particle size (Araújo et al. 2014). 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 particulate matter.

Because the primary source of criteria pollutant, VOC, and HAP emissions would be from construction and completion from future potential development of the nominated parcels, the Proposed Action would result in short-term increases in these emissions lasting an average of 25 days (see Table 3.7 and 3.8). Exposure to criteria pollutant emissions—particularly PM<sub>2.5</sub> and PM<sub>10</sub>—VOCs, and ground-level O<sub>3</sub> (as secondary emission) would pose a temporary nuisance for those living near the future oil and gas development. While levels of HAPs would also increase during construction and completion activities under the Proposed Action, these levels would be low relative to the distance from the source and would not pose a risk to human health (including cancer) because there would be no long-term exposure to elevated levels of toxic air pollutants.

#### 3.4.2.2. *Cumulative Impacts*

There are approximately 21,150 active oil and gas wells in the San Juan Basin. About 14,843 of the wells in these counties are federal wells with the remainder falling in other jurisdictions. While there are other sources of emissions in the analysis area, oil and gas development is one of the most prominent source of emissions. Current estimated emissions across the 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 3.6). Current estimated emissions and AQI ratings are reflective of the effects of past and present actions.

As with past and present actions, continued oil and gas development is the most prominent reasonably foreseeable future action affecting air quality in the analysis area. When combined with the impacts of past and present actions, the future potential development of the nominated lease parcels under the Proposed Action would incrementally contribute to increases in air quality emissions. The February 2018 Reasonable Foreseeable Development Scenario for Oil and Gas Activities (RFD 2018) estimates that there could be an additional 3,200 wells drilled by 2037 (Crocker and Glover 2018).

The two major sources of criteria pollutant and VOC emissions are the San Juan Generating Station and the Four Corners Power Plant. In addition to the recent shutdown of two of the units at the San Juan Generating Station at the end of 2017, the two units remaining in operation require installation of selective non-catalytic reduction technology. Overall, this is anticipated to result in a substantial decrease in current emissions of many criteria pollutants from the facility including a 67% reduction in SO<sub>2</sub>, 62% reduction in NO<sub>x</sub>, 50% reduction in particulate matter, 44% reduction in CO, and a 51% reduction in VOCs. Additionally, with the selective catalytic reduction technology installed on the two-remaining coal-fired generators at the Four Corners Power Plant, additional reductions in emissions from the facility, including a 36% reduction in NO<sub>x</sub>, a 43% reduction in particulate matter, and a 24% reduction in SO<sub>2</sub> (BLM 2017a). Therefore, it is expected that future levels of criteria pollutant, VOC, and HAP emissions would be lower than current levels due to these substantial decreases in emissions from the two major sources in the analysis area.

The San Juan Generating Station is also proposed for full closure by 2022, which would result in even further drops in future pollutant emissions for the analysis area. Additional measures taken to comply with recent revisions to the Regional Haze Rule in January 2017 would further reduce pollutant emissions. New Mexico will have to comply with these revisions as it develops its SIP for the second planning period (EPA 2018k).

### 3.4.3. Potential Mitigation Measures and Residual Effects

Based on its authority under the standard terms and conditions attached to leases, the BLM requires industry to incorporate and implement BMPs, which are designed to reduce impacts to air quality by reducing emissions, surface disturbances, and dust from field production and operations. Typical measures include adherence to 43 CFR Subpart 3179 concerning the venting and flaring of gas on Federal leases for natural gas emissions that cannot be economically recovered, flaring hydrocarbon gases at high temperatures to reduce emissions of incomplete combustion, watering dirt roads during periods of high use to reduce fugitive dust emissions, collocating wells and production facilities to reduce new surface disturbance, implementing directional and horizontal drilling and completion technologies whereby one well provides access to petroleum resources that would normally require the drilling of several vertical wellbores, suggestions that vapor recovery systems be maintained and functional in areas where petroleum liquids are stored, and performing interim reclamation to revegetate areas not required for production facilities and reduce the amount of fugitive dust.

In addition, the BLM encourages industry to participate in the Natural Gas STAR program 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. The USEPA 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.

### **3.5. Issue 2: How would the future potential development of nominated lease parcels contribute to greenhouse gas (GHG) emissions?**

The analysis areas associated with this issue are the state of New Mexico and the U.S. These geographic scales are used in this analysis to provide multiple levels of context associated with greenhouse gas (GHG) emissions as a result of leasing and future potential oil and gas development of the nominated lease parcels. In addition, the effects of GHG emissions are global in nature.

### 3.5.1. Affected Environment

Information about GHGs, their relationship to climate change, and their effects on national and global climate is presented in the Air Resources Technical Report (BLM 2017). Potential effects from GHG emissions would occur from any oil and gas development of the nominated lease parcels. Emissions of GHGs as a result of the proposed action would contribute to documented ongoing and reasonably foreseeable climate related effects. These effects include the following: 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 of 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 (Gonzales, 2018)

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.

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<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), and several other trace gases. These GHGs trap heat that would otherwise be radiated into space, causing earth’s atmosphere to warm and making temperatures suitable for life on earth. Water vapor is often excluded from the discussion of GHGs and climate change since its atmospheric concentration is largely dependent upon temperature rather than emissions by specific sources.

The two primary GHGs associated with the oil and gas industry are CO<sub>2</sub> and CH<sub>4</sub>. Because CH<sub>4</sub> has a global warming potential that is 21 to 28 times greater than the warming potential of CO<sub>2</sub>, the EPA uses measures of CO<sub>2</sub> equivalent (CO<sub>2</sub>e) which take the difference in warming potential into account for reporting GHG emissions (BLM 2017). Emissions are expressed in metric tons of CO<sub>2</sub>e in this document.

#### 3.5.1.1. *Methodology and Assumptions*

The BLM does not direct or regulate the end use of produced oil and/or gas. End uses of hydrocarbons extracted from the potential development of the nominated lease parcels could include the combustion of transportation fuels, fuel oils for heating and electricity generation, the production of asphalt and road oil, and the manufacturing of chemicals, plastics, and other synthetic materials. The BLM can only provide an estimate of potential GHG emissions using national approximations of where or how the end use may occur.

To establish the exact number of wells in the San Juan Basin is problematic due to the ongoing development of new wells, the abandonment of unproductive wells, land sales and exchanges, and incomplete or inaccurate databases. To estimate the number of active federal wells in the New Mexico portion of the San Juan Basin, BLM utilized geographic information systems data and the New Mexico Oil Conservation Division’s (NMOCD) Oil and Natural Gas Administration and Revenue Database (ONGARD; NMOCD 2015). An ONGARD search was conducted for all active, new, and temporarily abandoned federal wells in New Mexico in 2015; 16,289 wells were found in the San Juan Basin and 17,798 wells were found in the Permian Basin.

### 3.5.1.2. *Oil and Natural Gas Production and Emissions Estimates*

There is uncertainty with estimating GHG emissions during the production stage of oil and gas development, however some level of estimation can be provided using a top-down approach with various assumptions. This approach provides a level of comparison for GHG emissions associated with oil and gas production managed by the BLM to total oil and gas production emissions of the United States as well as to total emissions of all GHGs for the United States. To estimate the contribution of Federal oil and gas leases to GHG emissions in New Mexico, it is assumed that the percentage of total U.S. production is comparable to the percentage of total U.S. emissions. Therefore, emissions were estimated from the U.S. Energy Information Administration (EIA) based on total oil (USEIA 2018a) and gas (USEIA 2018b) production for the US and total GHG emissions for the US (EPA 2018d), and applying production percentages to estimate emissions for the San Juan Basin of New Mexico. The below table shows oil and gas production and estimated GHG emissions for the U.S., New Mexico, and the major federal oil and gas mineral estates of New Mexico. The estimated average annual GHG emissions per federal well in the San Juan Basin is 157 metric tons of CO<sub>2</sub>e.

**Table 3.6. 2016 Oil and Gas Production (USEIA 2018a, USEIA 2018b) and Estimated GHG Emissions (EPA 2018d).**

LOCATION	OIL (BBL)	% OF U.S. TOTAL	GAS (MMCF)	% OF U.S. TOTAL	ANNUAL GHG EMISSIONS (METRIC TONS CO <sub>2</sub> E)	% OF U.S. GHG EMISSIONS
United States	3,232,025,000	100	32,635,511	100	164,400,000	100
New Mexico	146,389,000	4.5	1,284,698	3.9	6,794,108	4.1
Federal minerals in New Mexico	70,010,962	2.2	788,776	2.4	3,837,013	2.3
<sup>1</sup> San Juan Basin	7,057,510	0.2	638,342	2.0	2,270,359	1.4
<sup>2</sup> Permian Basin	138,508,606	4.3	587,988	1.8	4,313,166	2.6

<sup>1</sup> Includes McKinley, Rio Arriba, Sandoval, and San Juan Counties

<sup>2</sup> Includes Chaves, Eddy, Lea, and Roosevelt Counties

### 3.5.2. Environmental Impacts

Impacts to GHG emissions from the Proposed Action include direct emissions from the development and construction of any potential wells on the nominated lease parcels and indirect (downstream/end use) emissions from the consumption of oil and natural gas products.

Direct GHG emissions of the Proposed Action are calculated assuming full development of the nominated lease parcels (28 oil and natural gas wells). Using the average annual oil and gas production emission value of 157 metric tons CO<sub>2</sub>e per well in the San Juan Basin and multiplying by 28 wells yields an estimate of 4,396 metric tons CO<sub>2</sub>e of annual direct GHG emissions from the Proposed Action. This represents an increase 0.0027% of the total annual GHG emissions from oil and gas production in the United States and an increase of 0.065% of the total annual GHG emissions from oil and gas production in New Mexico.

Potential indirect (downstream/end use) GHG emissions from the Proposed Action are estimated using oil and gas production values summarized in Table 2.2 (2,346,791 bbl of oil and 56,737,440 Mcf of natural gas). The challenge for estimating indirect emissions comes with understanding how oil and gas would be distributed and used for energy. Because this information is not typically available, an alternate method of calculating indirect GHG emissions based on estimated production data was developed for this analysis.

GHG combustion emission factors and global warming potentials were applied and converted to units of metric tons/Mcf and metric tons/bbl and finally metric tons of CO<sub>2</sub>e. GHG combustion emission factors and global warming potentials for natural gas and petroleum were obtained from 40 CFR Part 98, Subparts A and C. GHG indirect emissions from oil production are estimated to be higher than indirect emissions from natural gas production due to the higher carbon dioxide emission factor for oil. Table 3.7 estimates indirect GHG emission contributions for the Proposed Action using the EPA's GHG equivalencies calculator (EPA 2018d).

**Table 3.7. Estimated Indirect (Downstream/End Use) GHG Emissions (EPA 2018d).**

PRODUCT	ESTIMATED PRODUCT QUANTITY	EMISSIONS FACTOR	ESTIMATED EMISSIONS (METRIC TONS CO <sub>2</sub> E)
Crude Oil (bbl)	2,346,791	0.43 metric ton CO <sub>2</sub> /bbl	1,009,120.13
Natural Gas (Mcf)	56,737,440	0.055 metric ton CO <sub>2</sub> /Mcf	3,120,559.20
<b>Total</b>	-	-	<b>4,129,679.33</b>

### 3.5.2.1. Cumulative Impacts

Cumulative impacts of GHG emissions and their relationship to climate change are evaluated at the national and global levels in the Air Resources Technical Report (BLM 2017). Future development of the nominated lease parcels would contribute to increases in GHG emissions through both direct and indirect pathways. Additional contributions to GHG emissions would be through oil and gas development on existing leases, electricity generation, mining, and vehicle travel among other sources.

The increase in direct and indirect GHG emissions that could result from development of the nominated lease parcels would not produce climate change impacts that significantly differ from Alternative B – No Action Alternative. This is because climate change is a global process that is impacted by the sum total of GHGs in the Earth's atmosphere. The incremental contribution to global GHGs from the Proposed Action cannot be translated into effects on climate change globally or in the area of this site-specific action because it is currently not feasible to predict the net impacts on global or regional climate with certainty.

### 3.5.3. Potential Mitigation Measures and Residual Effects

The BLM requires industry to incorporate and implement BMPs, which are designed to reduce impacts to air quality, and subsequently GHGs, by reducing emissions from field production and operations. Typical measures include adherence to 43 CFR Subpart 3179 concerning the venting and flaring of gas on Federal leases for natural gas emissions that cannot be economically recovered, flaring hydrocarbon gases at high temperatures to reduce emissions of incomplete combustion, implementing 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, and provisions that vapor recovery systems be maintained and functional in areas where petroleum liquids are stored.

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.



### **3.6. Issue 3: How would future potential development of nominated lease parcels 40, 41, and 42 impact the wilderness experience in the Bisti/De-Na-Zin Wilderness?**

The analysis area for this issue is the northern end of the Bisti/De-Na-Zin Wilderness. This area was chosen because visual and auditory impacts from development of nominated lease parcels 40, 41, and 42 could impact the wilderness experience in this area. The Bisti/De-Na-Zin Wilderness was designated by congress in 1984 to provide for a wilderness experience.

In this analysis, acres of disturbance are used as an indicator of the amount of landscape change a visitor could see within the analysis area. Changes in noise levels (decibels) are used as an indicator of the amount of auditory impact from leasing and mining. Parcels 40 and 41 are approximately 1.25 and 1.5 miles north the boundary of the Bisti, and parcel 42 is immediately adjacent to the boundary (i.e., abutting). No leasing or development would take place within the wilderness boundary.

#### **3.6.1. Affected Environment**

The characteristic visual landscape of nominated lease parcels 40, 41, and 42 is that of a flat to rolling sagebrush grassland sloping southward towards badlands near the wilderness boundary. Previous and ongoing oil and gas development has occurred in this region to the north of the wilderness, however fewer active well locations are located within a mile of the wilderness boundary as compared to farther northward. The general region near lease parcels 40, 41, 42 includes oil and gas infrastructure (e.g. well pads, roads, and pipelines), scattered residences, Highway 371, and multiple transmission lines.

Ambient sound levels near nominated lease parcels 40, 41, and 42 vary depending on proximity to noise emitting sources, roadways, topography, vegetation, and weather conditions including temperature, wind, and humidity. Existing noise levels near the nominated lease parcels are generally low with the dominant noise sources coming from adjacent oil and gas operations, traffic on nearby roads, residences, grazing operations, and the hum of transmission lines.

BLM management goals for the Bisti/De-Na-Zin Wilderness are to preserve the natural character, solitude, and primitive recreation opportunities, and to preserve and protect the important scientific and educational resource values (BLM 2003). The wilderness character of the Bisti/De-Na-Zin Wilderness Area includes its many opportunities for primitive recreation in a setting of unusual and visually aesthetic geological formations. Wilderness values can be degraded if human activities impair the pristine qualities and naturalness of the wilderness setting

The visual landscape and noise levels within the wilderness depend largely on the distance from the wilderness boundary where adjacent oil and gas development (roads, oil and gas wells, etc.), residences, and Highway 371 contribute to the local viewshed and soundscape. Topography within the wilderness (open grasslands or enclosed badlands) is highly segmented and influences what a visitor is able to see and the amount of sound that is audible. Parcel 42 is located approximately 9 miles northeast of the main visitor's parking area for the wilderness and approximately 6 miles northwest of the De-Na-Zin visitor's parking area.

#### **3.6.2. Environmental Impacts**

Future potential development on parcels 40, 41, and 42 would introduce new visual features and noise to the surrounding landscape. As noted in Table 2-2, a single vertical well is anticipated for development on each of these three parcels which would disturb an estimated 13 acres of land.

Development would modify the visual environment through the removal of vegetation and alternation of the existing landscape during the construction of new well pads, roads, and pipeline corridors; the

addition of project related aboveground facilities to the landscape (e.g. pump-jacks, tanks, pipeline risers); the addition of traffic to local roads; and the addition of drilling rigs and potentially flares during drilling and completion activities. The construction, drilling, and completion phases would result in the greatest visual and auditory disturbance, but would be temporary, lasting approximately 45-60 days. Interim reclamation would occur following completion of any wells and would decrease the area of visual impacts by approximately half of the total acres of disturbance. Long term visual impacts would be from production facilities and un-reclaimed surfaces, and could cause visible contrast to form, line, color, and texture of the natural landscape.

Noise impacts associated with any development of the nominated lease parcels would be moderate to high during the construction, drilling, completion, or workover phases of any new wells, after which noise levels would be low and consistent during production and operation due to compressor engines, pump jacks, or other long-term sound sources.

Future potential development on parcels 40, 41, and 42 could affect the wilderness experience of visitors within the northern portion of the Bisti/De-Na-Zin Wilderness. Oil and gas infrastructure and operations from these lease parcels, especially parcel 42, could generate sights and sounds that intrude on the natural qualities and sense of solitude within the wilderness. Using viewshed analysis within GIS, much of the areas within the nominated lease parcels are not visible from within the wilderness. Noise is expected to attenuate to ambient levels at a distance of one (1) mile from the sound source. Due to the highly segmented nature of the badlands within the wilderness and the distance from the more frequented areas of the wilderness (trails and parking areas), it is unlikely that the wilderness experience within the Bisti/De-Na-Zin Wilderness would be impacted outside of one (1) mile from parcel 42. Parcels 40 and 41 are anticipated to have little impact on the wilderness experience due to their distance from the wilderness boundary.

#### 3.6.2.1. *Cumulative Impacts*

Approximately 50 active oil and/or gas wells are located within two miles of the northern boundary of the Bisti/De-Na-Zin Wilderness with many more in the general region. In addition, many wells have been plugged and reclaimed in this general region. Future potential development of nominated lease parcels 40, 41, and 42 is estimated to contribute three additional vertical wells and 13 acres of surface disturbance to the existing oil and natural gas viewshed and soundscape in this region. Oil and gas infrastructure and operations from these lease parcels, especially parcel 42, which directly abuts the Bisti/De-Na-Zin Wilderness, could generate sights and sounds that intrude on the natural qualities and sense of solitude within the wilderness.

Visual and auditory impacts from future potential development on these nominated lease parcels would remain for the lifetime of the development.

#### 3.6.3. *Mitigation Measures and Residual Effects*

Under the Standard Terms and Conditions, the BLM has the authority to implement mitigation measures in the COAs to reasonably reduce resource impacts at the APD stage. These could include measures to reduce visual impact such as painting production facilities with appropriate BLM Environmental Colors, using low profile tanks, equipment orientation, or moving well locations up to 200 meters. Measures to reduce auditory impacts could include mufflers and sound walls for noise attenuation.

### **3.7. Issue 4: How would future potential development of the nominated lease parcels impact the quality of night skies at the Bisti/De-Na-Zin Wilderness, Ah-shi-sle-pah Wilderness Study Area, and Chaco Culture National Historical Park (CCNHP)?**

The analysis area for this issue is the Bisti/De-Na-Zin Wilderness (Bisti), Ah-shi-sle-pah Wilderness Study Area (Ah-shi-sle-pah), and CCNHP. This analysis area was chosen because dark night skies is a value of the CCNHP which is managed by the National Park Service (NPS). CCNHP was designated as an International Dark Sky Park in 2013 and offers interpretive astronomy programs and stargazing at the Chaco Observatory. In addition, dark night sky quality in the Bisti and Ah-shi-sle-pah is sought after by users of these areas.

#### **3.7.1. Affected Environment**

Sources of light pollution can be from direct sources of light (light trespass) or sky glow. Night sky quality may be measured using a variety of metrics, and monitoring data are available through studies conducted by the NPS. Available sky quality and monitoring data specific to CCNHP is available and is assumed to be representative of the Bisti and Ah-shi-sle-pah. The effects of oil and gas development in the San Juan Basin related to night sky quality are also assumed to be similar for these areas. At this point, there are no existing or planned artificial light sources from within Indian Allotted lands within the Bisti.

The Sky Quality Index (SQI) is an index of light pollution from sky glow with a range of 0 to 100, where 100 is a sky free from artificial sky glow. Using data from the NPS, the SQI for the Gallo Cuesta monitoring station within CCNHP was 92.4 in 2013 and the SQI for the Pueblo Alto monitoring station was 82.8 in 2014 (NPS 2018). These values represent skies that retain their natural characteristics throughout most of the sky. Another measure is the Naked Eye Limiting Magnitude (NELM), which is a measure of the faintest stars that can be observed with the naked eye at the darkest part of the sky. The NELM values for both monitoring stations were 7.1, which is between excellent (7.4) and good (7.0). NELM values under 6.3 typically indicate significantly degraded sky quality (NPS 2018). Sky glow was noted to occur from surrounding cities including Farmington, Gallup, Crownpoint, and Albuquerque; as well as from drilling rigs and gas flaring to the north of Chaco Culture National Historical Park (2013 Gallo Cuesta monitoring report; NPS 2018). Overall, dark sky conditions within the region are good to excellent under current conditions.

#### **3.7.2. Environmental Impacts**

Future potential development on the nominated lease parcels could introduce artificial lighting to the landscape from sources such as infrastructure lighting, flaring, and traffic. The introduction of artificial lighting would contribute to sky glow and light trespass within the spatial analysis area. The degree to which artificial lighting contributes to sky glow is generally temporary and transient in nature. For example, most artificial lighting would occur during the drilling, completion, and potential flaring of a well which could last for approximately 45-60 days. Lighting from the other phases of development and production generally occurs from vehicle traffic and could in certain circumstances include security and safety lighting.

Light trespass from nominated lease parcels 40, 41, and 42 could be directly visible from the Bisti depending on distance and topography between a potential well and the wilderness, particularly Parcel 42 which directly abuts the wilderness. Parcel 31, located approximately 5.2 miles northeast of the Chacoan outlier of Pueblo Pintado, is the nearest parcel to CCNHP. Lighting from this parcel and the remaining parcels could potentially be visible, however this would depend on distance and topography.

Given that the NPS reports that the primary sources that contribute to an increase in night sky effects (sky glow) are cities, the BLM expects that contributions to sky glow from development of the parcels would be a small contribution to the existing sources. Leasing of the nominated parcels is not anticipated to result in major changes to the SQI or NELM ratings at CCNHP, however, these ratings could decrease while light sources are present on the landscape from any development of the nominated lease parcels. Distance and topography are assumed to shield the majority of project related illumination impacts to CCNHP. This impact could potentially be lesser in scope because the parcels are unlikely to be developed simultaneously. Indian allotted lands within the Bisti would be expected to feel this impact similar to Federal areas within the Bisti.

#### 3.7.2.1. *Cumulative Impacts*

NPS monitoring data indicates that dark sky conditions within CCNHP are good to excellent under current conditions, and primarily impacted by sky glow of adjacent cities. Reasonably foreseeable future actions in the analysis area include community and urban growth, and oil and gas development. The sky glow contribution from the nominated lease parcels combined with these future actions is not anticipated to result in major changes to the SQI or NELM ratings at CCNHP.

#### 3.7.3. Mitigation Measures and Residual Effects

Under the Standard Terms and Conditions, the BLM has the authority to implement mitigation measures in the COAs to reasonably reduce resource impacts at the APD stage. The BLM may require mitigation measures which could include flare shields, the type of lighting (limited to downcast lighting with covers for safety purposes only), and project alignment. Applicant-committed design features (ACDFs) could also be implemented by operators to reduce impacts.

### **3.8. Issue 5: How would the future potential development of the nominated lease parcels impact groundwater quality and quantity?**

The analysis area for this issue is a three-mile radius surrounding the nominated parcels. Permitted water wells and springs where the nominated parcels are located are very widely dispersed. This analysis area was chosen based on off-set oil and gas development that could be used to produce oil and gas resources within nominated parcels.

#### 3.8.1. Affected Environment

##### 3.8.1.1. *Groundwater in the San Juan Basin and a three-mile Radius Surrounding the Nominated Parcels*

Aquifers in the San Juan Basin are generally considered to be confined and artesian due to the overlying low hydraulic conductivity formations and the regional geologic structure, however, unconfined aquifers may be found at shallower depths (Stone et al. 1983). The New Mexico Bureau of Geology and Mineral Resources (NMBGMR) have defined the primary confined aquifers in the San Juan Basin to include the Ojo Alamo Sandstone, Kirtland Shale/Fruitland Formation, Pictured Cliffs Sandstone, Cliff House Sandstone, Menefee Formation, Point Lookout Sandstone, Gallup Sandstone, Dakota Sandstone, Morrison Formation, and Entrada Sandstone (Kelley et al. 2014). Groundwater is available in most of the FFO and is typically of poor to fair quality (Stone et al. 1983).

A summary of the points of diversion from the New Mexico Office of the State Engineer's (NMOSE) WATERS database (NMOSE 2017) within a three mile radius surrounding the nominated lease parcels is provided in Table 3.8. Analysis of the well data shows that groundwater is available in the area of the nominated lease parcels and may be found at shallow depths (a few hundred feet below ground surface).

An expired domestic water well permit was filed within parcel 45 according to the NMOSE's WATERS database. Groundwater wells used by the community of Ojo Encino are located near nominated parcels 11-17.

**Table 3.8. Points of Diversion within a Three Mile Radius of the Nominated lease parcels.**

PARCEL(S)	TOTAL POINTS OF DIVERSION	POINT OF DIVERSION STATUS	AVERAGE DEPTH (FEET)	AVERAGE DEPTH TO WATER (FEET)	POINT OF DIVERSION USE (NUMBER)
10	11	I	347	147	Domestic (9) Livestock (2)
11-17	8	Null (2) Active (4) Pending (2)	<sup>1</sup> 651	<sup>1</sup> 228	Domestic (1) Livestock (2) Mining (1)
24-25	5	Null (5)	<sup>2</sup> 280	N/A	Domestic (1) Livestock (4)
33, 36	11	Null (7) Active (3) Plugged (1)	<sup>3</sup> 975	<sup>3</sup> 328	Domestic (4) Livestock (3) Irrigation (1) Mining and Exploration (3)
37-39	4	Null (1) Active (2) Pending (1)	729	226	Domestic (3) Livestock (1)
40-46	14	Null (12) Active (2)	<sup>4</sup> 1,640	N/A	Domestic (10) Livestock (2) Oil and Gas (1) Irrigation (1)

<sup>1</sup>The values of average depth and average depth to water are heightened due to one well that is 2,238 feet deep and has a depth to water of 769 feet. With this well excluded, average depth would be 386 feet and average depth to water would be 119 feet.

<sup>2</sup>Only one well reported well depth.

<sup>3</sup>The values of average depth and average depth to water are heightened due to two well that are 2,221 and 2,245 feet deep and has a depth to water of 790 feet. With this well excluded, average depth would be 472 feet and average depth to water would be 235 feet.

<sup>4</sup>Only two wells reported well depths which were 730 and 2,550 feet.

Multiple springs/seeps are located within a three-mile radius of the nominated lease parcels using data from the national hydrography dataset (US Geological Survey 2013). The "Ojo Encino" spring/seep is located approximately 0.9 mile from parcel 14 and 1.1 miles from parcel 15; the "Ojo Sandoval Spring" spring/seep is located approximately 0.9 mile from parcel 29 and 1.1 miles from parcel 31. Unnamed spring/seeps are also located 2.2 miles from parcel 43, 1.5 miles from parcel 39, and 2.0 miles from parcel 17.

Residences surrounding the nominated lease parcels and the community of Ojo Encino are dependent on local water wells, water hauling, or may be supplied water from the Navajo Tribal Utility Authority (NTUA). Approximately 94% of houses in Ojo Encino are connected to the NTUA water system, and the Menefee and Mesa Verde water bearing aquifers were identified by the Chapter as deep and shallow groundwater sources (Ojo Encino 2016). The Navajo-Gallup Water Supply Project is scheduled to begin construction in 2018 to deliver water to the general region of Ojo Encino (Bureau of Reclamation 2018).

### 3.8.1.2. *Groundwater in Oil and Gas Operations*

Groundwater rights held by the oil and gas industry in the San Juan Basin are estimated to be 6,674 acre-feet per year, or approximately 6.3% of the total allocated rights in 2014. Mining (31.1%), domestic and municipal use (28.2%), and food production/irrigation (24.7%) were the major sources of allocated water use within the San Juan Basin (Kelley et al. 2014). Water use by the oil and gas industry was estimated to be approximately 2,244 acre-feet across New Mexico in water year 2010 while estimated total water use for McKinley, Rio Arriba, Sandoval, and San Juan Counties in water year 2010 was 659,597 acre-feet (Longworth et al. 2013).

Water used for drilling and well completion varies by the type and depth of a particular well. Kelley et al. (2014) estimated that recent horizontally drilled wells within the Mancos/Gallup formations of the San Juan basin used approximately 1,020,000 gallons of water on average per well for drilling and completion (3.1 acre-feet). Vertical wells were estimated to use approximately 150,000 gallons (0.5 acre-feet) for Mesaverde group wells, 207,000 gallons (0.6 acre-feet) for Gallup wells, and 105,000 gallons (0.3 acre-feet) for Dakota wells (Kelley et al. 2014). The 2018 RFD scenario estimated that water use for hydraulic fracturing of potential wells for the next 20 years would be 60 million barrels (2.5 billion gallons or 7,683 acre-feet; Crocker and Glover 2018). If more water intensive stimulation methods (e.g. slickwater fracturing) are implemented or if laterals become longer, water use could increase from estimates by Crocker and Glover (2018). Alternatively, water use estimates by Crocker and Glover (2018) could be lower if produced water is reused or recycled for use in hydraulic fracturing.

Stimulation (i.e., hydraulic fracturing or “fracking”) is a process used to maximize the extraction of hydrocarbons from reservoir rock formations to a well bore by allowing oil and/or natural gas to move more freely from rock pore spaces to production well piping that brings oil and/or gas to the surface. Stimulation techniques have been used in the United States since the 1940s (EPA 2016b), in the San Juan Basin since the 1950s, and are used in almost all new wells nationwide. Over the last 10 years, advances in multi-stage and multi-zone hydraulic fracturing have allowed development of gas fields that were previously uneconomic.

Fracturing and other well-stimulation techniques vary across the San Juan Basin depending on company preference, source water quality, site specific characteristics of the target geological formations, and the type of well. Water and sand typically make up 98% to 99% of the composition of fracking fluid, with chemical additives comprising the remaining 1% to 2% (EPA 2004, Groundwater Protection Council 2009, EPA 2016b). Chemicals added to fracking fluids may include friction reducers, surfactants, gelling agents, scale inhibitors, acids, corrosion inhibitors, antibacterial agents, and clay stabilizers (GWCP 2009). Nitrogen may be used in place of water for some fracking operations.

The New Mexico Oil Conservation Division (NMOCD) regulates state oil and gas operations in New Mexico. The NMOCD has the responsibility to gather oil and gas production data, permit new wells, establish pool rules and oil and gas allowables, issue discharge permits, enforce rules and regulations of the division, monitor underground injection wells, and ensure that abandoned wells are properly plugged, and the land is responsibly restored. The New Mexico Environment Department (NMED) administers the major environmental protection laws. The Water Quality Control Commission (WQCC), which is administratively attached to the NMED, assigns responsibility for administering its regulations to constituent agencies, including the NMOCD. The NMOCD administers, through delegation by the WQCC, all Water Quality Act regulations pertaining to surface and groundwater (except sewage not present in a combined waste stream).

The oil and gas producing zones of the nominated lease parcels could vary from shallower coalbed methane reserves to deeper oil and gas reserves located in sandstones and siltstones that are encased or surrounded both horizontally and vertically by the Mancos Shale interval.

Coalbed methane reserves are typically at shallower depths (less than 2,000 feet below ground surface) throughout the San Juan Basin. Development of coalbed methane resources is dependent upon the removal of water within the Fruitland formation to reduce pressure and allow methane molecules to detach from the surrounding coal matrix. Coalbed methane formation water is at times pumped for livestock use. The Kirtland Shale is a confining layer that overlies the Fruitland formation and is thought to provide a hydraulic barrier to overlying shallow aquifers from hydrocarbon development within the Fruitland formation.

The Mancos Shale interval is over 2,000 feet thick and below commonly used underground sources of drinking water. The Mancos Shale formation is in itself a barrier to fluid migration and is also overlain by the Lewis Shale and the Kirtland Shale formations that are also geological confining layers. The Lewis Shale (up to 2,000 feet thick) and the Kirtland Shale (up to 1,500 feet thick) are impermeable layers that isolate the Mancos Shale and Mesaverde formations from both identified sources of drinking water and surface water. Total depth of proposed well bores in the Basin Mancos formation would be around 5,000 feet below the ground surface. Current fracturing in the Basin Mancos formation is not expected to occur above depths of 4,000 feet below the ground surface. Fracturing is not likely to extend into the Mesaverde formation from the lower portion of the Basin Mancos formation because of its depth.

### 3.8.2. Environmental Impacts

Potential impacts to groundwater resources would vary depending on the type of oil and gas reserves developed from the nominated lease parcels. Examples of potential impacts could include groundwater depletion, the dewatering of adjacent water wells, contamination or cross-contamination of aquifers, and fluid spills that reach the groundwater (EPA 2016b). Contamination or cross-contamination of groundwater resources would most likely occur from a mechanical or integrity failure of the well or by an undesired migration of gases or liquids within targeted formations or into adjacent geologic formations. Mechanical integrity failures of wells are typically associated with problems with the well casing and cement quality.

Coalbed methane development has had varying levels of impact on groundwater and associated resources within the San Juan Basin, particularly within the northern portion of the basin in Colorado near outcrops of the Fruitland formation. These issues include the migration and seepage of methane, the dewatering of adjacent water wells, vegetation die offs, and an overall depletion of groundwater from the Fruitland aquifer (BLM 1999; BLM and USFS 2006).

Water wells, springs, and seeps within and adjacent to (within a three-mile radius of) the nominated lease parcels could be affected by oil and gas development if groundwater levels drop or if they are contaminated as a result of oil and gas development. The nominated lease parcels are generally located in areas with shallow groundwater.

Drilling and completion of oil and gas wells in the nominated lease parcels was estimated to use approximately 28.2 million gallons or 86.5 acre-feet of water based on the number and type of well (Table 2.2) and values from Kelley et al. (2014). Vertical wells were assumed to use approximately 175,000 gallons of water (0.54 acre-feet) for drilling and completion and horizontal wells were assumed to use 1,040,000 gallons of water (3.2 acre-feet) for drilling and completion. Produced water production from the nominated lease parcels was estimated to approximate 3,352,174 barrels of water (324 acre-feet).

#### 3.8.2.1. Cumulative Impacts

The estimated water use for drilling and production on the nominated lease parcels is 86.5 acre-feet. This is approximately 1.2% of the estimated water needed for drilling and completions in the 2018 RFD

scenario and approximately 3.9% of the water use by the oil and gas industry in 2010 in New Mexico. In particular, the percentage of the projected future potential development groundwater water use to total county groundwater withdrawals is: 0.15%, 0.06%, and 0.35% for the counties of McKinley, Rio Arriba, and Sandoval, respectively. This comparison is not meaningful for San Juan County because most of its water use is from surface water (83%). Since these numbers are so low in comparison to 2010 withdrawals, the BLM does expect this lease sale to have a significant impact to surface or groundwater quantities.

The water demand to complete any future wells that could be drilled from the nominated lease parcels is not expected to exceed past development demands within the San Juan Basin and is within the estimated use noted in the 2018 RFD scenario (Crocker and Glover 2018).

The cumulative withdrawal of water from the Fruitland formation from coalbed methane wells could contribute to an overall depletion of local groundwater resources within the Fruitland aquifer system. Groundwater in this system would begin to recharge after hydrocarbon development, however this process could take a century or more to return to prior water levels (as noted in BLM and USFS 2006).

### 3.8.3. Mitigation Measures and Residual Effects

The BLM and NMOCD's casing, cementing, and inspection requirements would limit the potential for groundwater reservoirs and shallow aquifers to be impacted by fracking or the migration of hydrocarbons on the nominated lease parcels. Prior to approving an APD, a BLM geologist would identify all potential subsurface formations that would be penetrated by the wellbore including groundwater aquifers and any zones that would present potential safety or health risks that would need special protection measures during drilling, or that could require specific protective well construction measures. Casing programs and cement specifications would be submitted to the BLM and NMOCD for approval to ensure that well construction design would be adequate to protect the subsurface environment, including known or anticipated zones with potential risks or zones identified by the geologist. Surface casing would be set to an approved depth, and the well casing and cementing would stabilize the wellbore and provide protection to any overlying freshwater aquifers by isolating hydrocarbon zones from overlying freshwater aquifers. Before hydraulic fracturing takes place, all surface casings and intermediate zones would be required to be cemented from the bottom of the cased hole to the surface. The cemented well would be pressure tested to ensure there are no leaks, and a cement bond log would be run to confirm that the cement has bonded to the steel casing strings and to the surrounding formations.

Water for any oil and gas development activities would be sourced in compliance with all Federal and state laws and regulations. Produced water would be disposed of at regulated and permitted commercial facilities (such as saltwater disposal wells) or would be used in the drilling and completion of wells. Saltwater disposal wells would be subject to the specifications mentioned above, including having the correct casing and cementing program, as well as pressure testing to protect groundwater formations. Groundwater wells generally do not occur in formations where produced water is disposed of.

### 3.9. Issue 6: How would future potential development of the nominated lease parcels impact cultural resources?

Oil and gas development involves at least two undertakings: the leasing of the minerals and the site specific development of the lease(s) through submittal of an APD(s). The BLM FFO has assessed 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, would occur later, at the APD stage. The BLM FFO has reviewed data from the New Mexico Cultural Resources Information System (NMCRIS) database, Navajo Nation Heritage and Historic Preservation Department (NNHHPD) records, and BLM FFO's own legacy paper maps to identify known



historic properties and other cultural resources within the project's APE. Specifically, the BLM FFO identified relevant sites in each of the direct and indirect effect APEs. Direct effects can 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 indirect 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).

In addition, the BLM FFO searched alternative data sets and ethnographic reports to identify additional cultural resources and potential historic properties not represented in NMCRIS. These sources include databases of Chacoan outliers and known Chacoan road segments, a database of early Navajo historic defensive sites (pueblitos), and various ethnographic reports including the 2006 ethnographic study conducted as part of the BLM FFO 2003 RMP and the 2013 ethnographic overview of the San Juan Basin prepared for Bureau of Reclamation's Navajo-Gallup Water Supply Project. The BLM FFO examined the potential for unrecorded Chacoan road segments in the APE through a combination of projections from known Chacoan road segments, alignments visible in PII-PIII era sites represented in NMCRIS, and digital elevation models derived from the BLM FFO's 2016 bare-earth lidar data collection near CCNHP.

Due to the high level of concern previously expressed by tribes and the public regarding potential indirect effects of oil and gas development on Chacoan sites and other especially sensitive cultural resources, the analysis of potential effects addressed key resources that may fall outside the designated APE. Utilizing concepts and procedures outlined in BLM Manual 8431 (Visual Resource Contrast Rating), the FFO determined the potential for foreseeable development on the parcels to create weak, moderate, or strong visual contrast from the perspective of an observer at sites including Chaco Culture Archaeological Protection Sites (PL 96-550) and the Chaco Great North Road. All UNESCO World Heritage Sites pertaining to the Chaco Culture listing and outside the main unit of CCNHP are a subset of the Chaco Culture Archaeological Protection Sites.

Appendix C of the Wyoming State Protocol between BLM and SHPO, for which this cultural analysis is modeled, offers a tested methodology for assessing the potential for visual impacts to distant sites through the mechanisms of BLM's existing VRM program. It associates visual contrast ratings with effects to historic properties sensitive to viewshed impacts in the following manner:

- No visual contrast = no historic properties affected;
- Weak visual contrast = no adverse effect to sensitive historic properties; and
- Moderate or strong visual contrast = adverse effect to sensitive historic properties.

While developments more than one mile from the direct APE are unlikely to require treatment besides the application of standard environmental colors to effectively eliminate visual contrast and yield no effect to historic properties, this review helps ensure the most prominent and sensitive resources are given full consideration during the assessment of effects. It also tests the appropriateness of the indirect APE.

Cultural resource analysis considers various subsets of historic properties and potential impacts at various distances from each lease parcel. For the purposes of identification and consultation under NHPA Section 106, the area of potential effect (APE) for direct effects -- areas in which construction of facilities may physically damage sites -- is defined as a ¼ mile buffer of the lease parcels. The areas of parcels with NSO stipulations on new leases, areas outside parcels closed to new ROWs, and portions within the West Wide Energy Corridor are excluded from the direct effects APE. The APE for indirect effects extends one mile beyond this, or the distance in which special actions in addition to common, universal ACDFs may

be necessary to avoid or mitigate adverse effects to historic properties. That is, it approximates areas in which noise generated by operational well pad equipment may significantly rise above natural and existing anthropogenic sounds under typical atmospheric conditions and the area in which the use of environmental colors may not be enough to negate visual contrast against the background. Additionally, existing guidance for the VRM program (Manual H-8410-1) defines the foreground-middleground and background zones as areas in which development could yield significant impacts to a sensitive location. Due to this and the intense concern from Native American tribes and the public over indirect impacts to Chacoan sites, this analysis also identifies Chacoan sites and similarly high-profile properties between 1.25 miles and 15 miles from each parcel and examines the potential for significant impacts. Typically, a visual extent of 5 miles, not 15 miles, is appropriate in most other circumstances. The indirect effects APE of a parcel should be expanded to include any such sensitive properties that exist within the 15-mile viewshed for which further analysis determines that ACDFs would not negate visual contrast or other long-range impacts. Pursuant to 36 CFR 800.4(a), the Federal agency determines the APE for an undertaking, in consultation with the appropriate State Historic Preservation Officers (SHPOs) outside of tribal lands and/or Tribal Historic Preservation Officers (THPOs) on tribal lands. Further details regarding on-going Section 106 consultation is included in Chapter 4.

### 3.9.1 Affected Environment

The San Juan Basin contains high densities of historic properties, including high-profile properties significant for reasons other than archaeological data potential (i.e., eligible for listing on the National Register of Historic Places [NRHP] under Criteria A, B, or C). While few have been formally evaluated as Traditional Cultural Properties (TCPs) following identification measures outlined in NPS National Register Bulletin 38, many are likely to be sites of traditional religious and cultural significance for Native American tribes in the region. For example, the Hopi Tribe has explicitly identified Chaco Canyon (State Register [SR] 57 and CCNHP) to FFO as a TCP, but the Navajo Nation, the Hopi Tribe, and most New Mexico Pueblos have stated that many Chacoan sites, in general, are significant for religious and cultural values. Based on the above records review description and analysis, the total (direct and indirect) APEs of the lease parcels under analysis range from 1 site every thirteen acres to 1 site every two hundred sixty acres. While most of these are significant for their archaeological data potential (i.e., eligible for NRHP listing under Criterion D alone) and therefore not susceptible to indirect effects such as viewshed or soundscape impacts, less than 1% of known sites in the total APE are potentially eligible under Criteria A, B, or C and could suffer diminished integrity of setting, feeling, or association due to non-physical impacts. It should be noted, however, that these values are tentative, pending conclusion of the identification phase of the Section 106 process.

### 3.9.2 Environmental Impacts

Due to the dispersed nature of oil & gas development, requirements to identify sites through Class III (100% pedestrian) inventories by cultural resources specialists at the APD stage, and the ability to avoid sites through minor reroutes or modifications to projects, fluid minerals extraction results in few direct effects to historic properties. Similar identification and treatment requirements for developments associated with residential sites likewise results in the avoidance of the vast majority of historic properties. This is in contrast with large-scale infrastructure projects (e.g., large water pipelines, highways, transmission lines) and mining activities (e.g., surface coal mines) that routinely cause adverse effects to historic properties, necessitating the development of mitigation strategies.

However, dispersed development may create regional effects such as increased access, ground vibrations, noise, viewshed intrusions, etc. that have the potential to adversely affect historic properties. In many cases, past effects are difficult to quantify in existing data sets. One reason for this is that the definition of a given site's significance and what constitutes an effect or adverse effect is based in part on academic consensus and available information, both of which evolve over time. The Chacoan Outliers Protection

Act of 1995 recognizes Chacoan sites as significant for archaeological data potential and susceptible only to direct effects from development. But these sites also possess additional traditional religious and cultural significance. Viewshed and soundscape impacts to these sites may be capable of meeting the threshold for adverse effect, either singly or cumulatively. While external parties and the FFO have recently attempted to identify and describe existing soundscape and viewshed impacts at key locations such as the Chacoan outliers Pierre’s Site and Twin Angels, most existing cultural resources data sets (e.g., NMCRIS) do not adequately capture these effects (see Van Dyke 2017, Haymes 2018). Simply, in contrast to direct effects, atmospheric impacts that might be considered adverse effects today would not necessarily have been considered as such in the past. No identified Chacoan outliers or road alignments are within 1.25 miles of the lease parcels. Table 3.9.1 lists Chacoan sites within the foreground-middleground or background zones of the parcels.

**Table 3.9.1 High-profile, sensitive historic properties within the foreground-middleground or background zones of the nominated lease parcels.**

HISTORIC PROPERTY	NEAREST PARCEL(S)	DISTANCE (MILES)	IN/OUT OF VIEWSHED*	H-8410-1 VRM DISTANCE ZONE	ALL PARCELS IN 15 MILES
Ah-shi-sle-pah Road (LA44668, LA44669, etc.)	42	11.4	In	Background	40, 41, 42, 46
Bis Sa’ani (LA17286 & LA17287; ACEC)	33	6.5	In	Background and seldom seen	26, 33
Chaco Canyon (CCNHP; SR 57)	41	9.5	In	Background	33, 41
Chaco Great North Road (LA34282-34293, LA34295-34296, LA108206, etc.)	42	9.1	In	Background and seldom seen	33, 37, 38, 39, 41, 42, 46
East Community	33	12.2	Out	Seldom seen	26, 33
Greasy Hill	33	12.5	In	Background	33
Halfway House (LA15191)	40	6.2	Out	Seldom seen	37, 38, 39, 40, 41, 42, 46
Kin Indian Ruin	33	13.3	In	Background	33
Pierre’s Site (LA16508, LA16509, LA35423, LA16514, LA16515, etc)	40	10.2	Out	Seldom seen	33, 39, 40, 41, 42
Pueblo Pintado (LA574; CCNHP detached unit)	26	10.5	Out	Seldom seen	16, 26, 33
Raton Well	11	6.2	In	Background and seldom seen	11, 12, 13, 14, 15, 16, 17
Reservoir Ruin	11	9.7	In	Background and seldom seen	11, 12, 13, 14, 15, 16, 17
Tse Lichii	33	14.8	Out	Seldom seen	33

There are approximately 488 active fluid minerals wells within the indirect APE of the lease parcels. In addition, the APEs include non O&G developments such as: roadways, water pipelines, and transmission lines. Construction activities, though of short duration themselves, could permanently damage most classes of historic property in the direct effects APE through physical destruction. These direct effects are rare, as the Section 106 process strongly encourages the avoidance of effects through facility relocation, ROW restriction, temporary or permanent protective barriers, and other measures. In addition, short-term construction activities create close-range indirect effects such as vibrations and elevated potentials for vandalism, as well as indirect atmospheric effects such as intrusions on the viewshed and soundscape of

sites well above the levels experienced once normal production begins. While the direct effects of development create permanent impacts to sites, destroying irreplaceable archaeological data potential, indirect effects are transient and may be fully or partially resolved with final reclamation of the facilities.

The presence and normal operation of oil and gas facilities may create persisting adverse effects to sensitive historic properties anywhere in the direct or indirect APE. Such effects take the form of atmospheric effects such as viewshed or soundscape impacts that undermine less tangible aspects of a site's integrity, such as setting or feeling.

### *3.9.2.1 Cumulative Impacts*

Cumulative impacts to cultural resources are based on past, current and reasonably foreseeable direct and indirect effects within the spatial scope of the current action. For direct effects, the spatial scope is 0.25 mile from the exterior boundaries of the nominated parcels, For the indirect effects, this spatial scope is 15 miles from the exterior boundaries of the direct APE. Past and current oil and gas impacts within a fifteen mile indirect effects buffer are a total of 16,037 facilities/equipment associated with oil and gas extraction. Within the quarter mile direct effects buffer are a total of 75 facilities/equipment associated with oil and gas extraction. The foreseeable future development of the area that would be impacted by this spatial environmental scope would include the potential of 28 new wells from the New Mexico BLM March 2019 Oil and Gas Lease Sale. This increase represent a 0.17% increase in oil and gas extraction facilities over the entire 15 mile indirect effects area and a 37.33% increase within the direct effects area. The apparent dramatic increase of 37% is due to the relatively few oil and gas related facilities/equipment within the direct effects APE and the lack of facilities/equipment within the parcels. There are no other foreseeable impacts to the direct and indirect environments other than oil and gas leasing.

### 3.9.3 Mitigation Measures and Residual Effects

Any impacts rising to the level of adverse effects would likely be mitigated through the Section 106 process. All lease parcels include the WO-NHPA and NM-11-LN stipulations, allowing for effects to be mitigated. There is an infrequently-used process by which an agency may complete the Section 106 process without mitigating adverse effects, following non-concurrence with consulting parties and the Advisory Council on Historic Preservation (ACHP). In almost all cases, the Section 106 process eventually concludes with consulting party and SHPO/THPO concurrence on an agency's finding of no effects or no adverse effects, concurrence from the ACHP, or the development of an agreement document with consulting parties outlining a strategy to mitigate adverse effects to historic properties. Mitigations to resolve adverse effects at the leasing stage could include alternative mitigations, such as advanced site identification or study through remote sensing, intensive field study, or ethnography. In most instances, direct or indirect effects would be avoided or mitigated through Administrative Collaboration and decision making (ACDM) or COAs at the APD stage, or through mitigations developed through Section 106 consultation at the APD stage. Based on the cultural resource review analysis and available stipulations, FFO anticipates a determination of no adverse effect to cultural resources.

### **3.10. Issue 7: How would future potential development of the nominated lease parcels impact Native American traditional, cultural and religious concerns?**

The spatial/geographical scope of analysis for this issue varies by type of impact. For visual impacts, the 161.30 acres of ground disturbance plus any above-ground structures or facilities related to oil and gas production would be largely unnoticeable to the observer at a distance of 5 miles, assuming flat topography.

An assumption was made during this analysis is that the RFD equals approximately one randomly placed well per parcel. A second assumption made is that BLM's foreground-middleground zone (out to 3-5 miles) is the maximum area of potential effect (APE) for visual effects from oil and gas development (Haymes 2018). Additional concerns were identified and viewshed analyses were conducted to a distance of 15 miles from sensitive locations.

For audible impacts, the baseline (ambient) sound levels in the project study areas vary, depending on proximity to existing facilities, roadways or other sources as well as weather conditions including temperature, wind and humidity, and the general topography of the area. For the purposes of analysis, it is assumed that ambient sound is 50 decibels (dB) (Navajo Reservoir RMP/FEA, June 2008). It is assumed that the sound generated during drilling, operation, and completion of oil and gas wells will be reduced to near ambient background levels at a ½ mile range based on the rate of sound attenuation with distance from the source. The analysis will discuss impacts related to construction and operation of oil and gas infrastructure during the life of the leases, which in this area is estimated to be 20 years.

### 3.10.1 Affected Environment

Visual and audible impacts to locations and areas of Native American religious and cultural importance from the proposed alternatives could occur through alteration of the landscape from direct disturbance of the drilling, operation, and completion of oil and gas wells. This is predicted to cause direct physical ground surface disturbance to 161.30 acres. Native American tribes and Pueblos have identified the existence of areas and resources of concern through consultation for this and previous actions. In addition, the Navajo Nation Heritage and Historic Preservation Department (NNHHPD) maintains Navajo Traditional Cultural Properties (TCPs) information, which consultation was initiated on October 12, 2018. This information coupled with existing ethnographic studies and other information gathered during previous consultations forms the basis for the affected environment. The FFO invited the tribes and pueblos listed in Chapter 4 of this document to consult on this action by certified letter sent on October 12, 2018. To supplement information provided during consultation, the FFO cultural staff has compiled a geographic information system (GIS) database of known TCPs, sacred sites, and traditional use areas within the field office. This database is based on Van Valkenburgh (1974), Kelly et al. (2006), York and Winter (1988), cultural resource Section 106 compliance reports and site forms. No fewer than 319 known culturally sensitive locations for the Navajo people have been identified within the 15 mile visual buffer, further, a review of the records housed at the Navajo Nation Heritage and Historic Preservation Department (NNHHPD) were reviewed the week of December 10, 2018. Because Chacoan sites were identified as being of concern for Pueblos, archaeological databases were also consulted to identify Chaco-affiliated sites within the geographical extent of the analysis area. A review of ARMS and The Chaco Archive revealed twenty Chaco-affiliated sites within the 15 mile visual buffer. This includes seventeen Chacoan pueblos (eight of which are within CCNHP itself) and three different Chacoan roads.

The consultation effort to date has only resulted in the receipt of two letters, one each from the Hopi Tribe and the Pueblo of San Felipe. These letters expressed the desire for further consultation and an opportunity to review and comment on the soon to be completed cultural resources literature review. Both letters mentioned the continued importance of the region and opposition to the lease sale moving forward.

Consultation meetings are expected after all consulting parties have had a chance to read the literature review.

### 3.10.2 Environmental Impacts

Developing oil and gas facilities on the proposed lease parcels would include construction operations and long-term placement of structures and would require approximately 12 acres of vegetation clearing and land leveling, including access routes. The removal of vegetation and reforming of land would lead to contrasts to the existing landscape by altering the original elements of form, line, color and texture. There would be a direct impact of alteration to 161.30 acres of existing landscape that could be seen from a distance of 5 miles, although viewshed analyses were run up to 15 miles, from the specific location of the disturbance, assuming flat topography. Areas that may contain locations or landscape of concern to tribes and pueblos could be impacted by this visual alteration. Following standard BMPs for VRM mitigation, such as painting using environmental colors, siting of well location, and performance of interim and final reclamation, the visual impacts are not anticipated to be significant.

For areas of concern to tribes and pueblos, the disturbance and operation of a well would be audible up to a half mile from the well, at which point the noise level would drop to ambient. The audible effects would be greatest on the well pad, but would fall off at a rate of 6 dB for every doubling of distance. Assuming ambient noise in the area of the parcels is 45 dB, within 0.5 mile of a well the sound of drilling, operation, and completion would drop to ambient. Although eliminating audible impacts from future oil and gas operations is difficult, well siting and the potential to delay drilling operations by up to 60 days per regulation can mitigate or minimize impacts.

The stipulations applied to the parcels will give FFO sufficient authority to ensure future developments avoid direct effects and adverse indirect effects. Conditions of approval requiring the relocation of a proposed facility to an area outside of any TCP candidates, relocation to an area several hundred feet from the property, and/or “hospital” mufflers to reduce noise may be attached to augment standard BMPs that reduce visual or auditory impacts, including the use of matching environmental colors for aboveground facilities.

#### 3.10.2.1 *Cumulative Impacts*

Cumulative impacts to Native American religious concerns are based on past, current and reasonably foreseeable visual and audible impacts within the spatial scope of the current action. For visual, this spatial scope is 15 miles from the exterior boundaries of the nominated parcels. For audible, it is 0.5 mile from the exterior boundaries of the nominated parcels. Past and current oil and gas impacts within a fifteen mile viewshed buffer are a total of 16,037 facilities/equipment associated with oil and gas extraction. Within the one half mile audible buffer are 148 facilities/equipment associated with oil and gas extraction. The foreseeable future development of the area that would impact the visual and audible environment include the potential for 28 new wells from the New Mexico BLM March 2019 Oil and Gas Lease Sale. This increase represent a 0.17% increase in oil and gas extraction facilities over the entire 15 mile visual area and a 18.92% increase within the audible analysis area. The apparent dramatic increase of 18.92% is due to the relatively few oil and gas related facilities/equipment within the direct effects APE and the lack of

facilities/equipment within the parcels. There are no other foreseeable impacts to the visual and audible environments other than the two oil and gas lease sales.

Cumulative impacts to cultural resources are based on past, current and reasonably foreseeable direct and indirect effects within the spatial scope of the current action. For direct effects, the spatial scope is 0.25 mile from the exterior boundaries of the nominated parcels, For the indirect effects, this spatial scope is 15 miles from the exterior boundaries of the direct APE. Past and current oil and gas impacts within a fifteen mile indirect effects buffer are a total of 16,037 facilities/equipment associated with oil and gas extraction. Within the quarter mile direct effects buffer are a total of 75 facilities/equipment associated with oil and gas extraction. The foreseeable future development of the area that would be impacted by this spatial environmental scope would include the potential of 28 new wells from the New Mexico BLM March 2019 Oil and Gas Lease Sale. This increase represent a 0.17% increase in oil and gas extraction facilities over the entire 15 mile indirect effects area and a 37.33% increase within the direct effects area. The apparent dramatic increase of 37% is due to the relatively few oil and gas related facilities/equipment within the direct effects APE and the lack of facilities/equipment within the parcels. There are no other foreseeable impacts to the direct and indirect environments other than oil and gas leasing.

### 3.10.3 Mitigation Measures and Residual Effects

The standard WO-NHPA stipulation (Appendix C) attached to all parcels states that BLM will not approve any ground-disturbing activities until it conducts its tribal consultation obligations. BLM may require modification to exploration or development proposals or disapprove any activity that is likely to result in adverse effects that cannot be successfully avoided, minimized, or mitigated. If projects are proposed on any leased parcel in the future, each would be analyzed under project-specific NEPA analysis. At that time the BLM would consult with the tribes and site-specific mitigation measures would be attached as Conditions of Approval (COAs).

In addition to the national WO-NHPA stipulation, a second stipulation for cultural resource protection would be attached to all parcels leased. NM-11-LN (Cultural Resources) (Appendix C) requires compliance with Section 106 and Executive Order 13007. This stipulation notifies the lease holder that known and as yet unidentified cultural properties may be present within the lease area, that compliance with Section 106 and EO 13007 will be at the lessee's expense, that additional tribal consultation will be required, that time frames may be extended to carry out such compliance, and that BLM could require modifications to or disapprove proposed activities that are likely to adversely affect cultural properties for which no mitigation measures are possible.

Enforcement of all stipulations during any future authorizations to conduct exploration or operational activities under a lease will result in a preliminary finding of no adverse effects to Native American Religious Concerns; however consultation is ongoing. Through the cultural resource protection stipulations attached to all leases, BLM has the authority to require modification of, or disapprove, parcel development plans if cultural resource conflicts cannot be satisfactorily resolved. This gives BLM the authority to control future development to avoid

adverse effects, including, but not limited to, those that would cause a degradation of setting and other indirect effects.

### **3.11. Issue 8: How would future potential development of the nominated lease parcels impact environmental justice communities and their quality of life?**

Environmental justice communities are defined in Executive Order 12898. The analysis area for this issue is the Chapter House boundaries that contain the nominated lease parcels. Parcel 10 does not exist within a Chapter House boundary, so the analysis area is Rio Arriba County, where the parcel is located. This analysis area was chosen because the Chapter House boundaries that contain the nominated parcels are home to the environmental justice communities that could see impacts to quality of life by future potential development of the lease parcels.

For this analysis, “quality of life” is defined as “a feeling of well-being, fulfillment, or satisfaction resulting from factors in the external environment” (Greenwood, n.d.). The quality of life definition was chosen for the focus on external environmental factors and due to a lack of data on existing quality of life issues for the analysis area.

#### **3.11.1 Affected Environment**

The purpose of Executive Order 12898 is to identify and address, as appropriate, disproportionality high and adverse human health or environmental effects on low income populations, minority populations, or Indian Tribes (Chapter Houses in this instance) that may experience common conditions of environmental exposure or effects associated with a plan or project. 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.

The FFO is home to a wide variety of cultural, ethnic, and tribal communities. Multiple indigenous Native American populations inhabit the study area, and many Hispanic residents can trace their family’s history of settlement of northern New Mexico back hundreds of years. These traditional and indigenous communities are intermingled with more recent Euroamerican groups and immigrants. Ranchers, miners, farmers, oil and gas workers, and service industry providers are all part of the socioeconomic mixture of people in the FFO.

The nominated lease parcels are located within rural areas of San Juan, Rio Arriba, McKinley, and Sandoval Counties of New Mexico. 27 of the nominated lease parcels are located on Navajo Nation Tribal Trust surface; the remaining parcels are BLM or private surface. Parcels 11-17 are located within the Ojo Encino Chapter House boundary. Parcels 24-28, 30, and 32 are within the Counselor Chapter House. Parcels 29, 31, 33-36, and a portion of 39 are within the Nageezi Chapter House. The remaining portion of parcel 39 and parcels 37, 38, and 39-46 are within the Huerfano Chapter house. Parcel 10 is not located within a Chapter House boundary, but is located within Rio Arriba County near the community of Lindrith. Using satellite imagery and site visits, the BLM FFO determined that 13 parcels have residences or older structures within them. Many of the remaining parcels have one or more residences or structures within a mile of their boundary.

The nearest communities to the nominated lease parcels are Huerfano, Lindrith, Nageezi, Ojo Encino, Pueblo Pintado, and Counselor. Data on population, percent minority, percent Native American, income level, and poverty rates in affected Navajo Nation Chapters; as well as McKinley, Rio Arriba, Sandoval, and San Juan Counties; and the State of New Mexico from the US Census Bureau (USCB) are provided in the below table (USCB 2018).



**Table 3.11.1 Population, Percent Minority, Percent Native American, Income Level, and Poverty Data for Areas near the Nominated lease parcels Including Navajo Nation Chapters, Counties, and the State of New Mexico.**

LOCATION	POPULATION	MINORITY (%)	NATIVE AMERICAN (%)	PER CAPITA INCOME (\$)	MEDIAN HOUSEHOLD INCOME (\$)	POVERTY RATE (%)
Nageezi Chapter	900	99	98	8,912	18,375	53
Ojo Encino Chapter	597	100	97	7,335	20,000	55
Counselor Chapter	762	100	92	7,480	14,375	68
Huerfano Chapter	2,708	98	95	10,721	27,500	38
McKinley County	72,564	92	74	16,305	31,565	41
Rio Arriba County	39,924	87	14	19,600	33,972	23
<sup>1</sup> Sandoval County	142,507	57	12	25,798	54,296	18
San Juan County	126,926	62	38	20,719	45,942	25
New Mexico	2,088,070	63	9	25,311	46,744	20

<sup>1</sup> Northern Sandoval County is primarily rural, with dispersed ranching and tribal communities scattered widely throughout the northeastern quarter of the county. Southeastern Sandoval County contains the rapidly growing communities of Rio Rancho and Bernalillo and associated suburban expansion. The presence of these communities in the southern part of the county accounts for the large difference in population and income relative to the other analysis areas in the table.

Based on BLM FFO experience with the area of the Proposed Action and the residents within, it is assumed that data on percent minority, percent Native American, income, and poverty for the Navajo Nation Chapters is more representative of residences and communities near the Proposed Action than those of local counties or larger towns in the region.

As seen in the above table, nearby Navajo Nation Chapters range from 98-100% minority and 92-99% Native American. Poverty rates for these Chapters ranges from 38-68%. Per capita income for these Chapters is below the poverty threshold, and median household income is below the poverty threshold for these Chapters except the Huerfano Chapter which is just above the poverty threshold. In general, income is lower, poverty is higher, and the percentage of minority and Native American populations are higher near the Proposed Action than in surrounding cities, counties, and the State of New Mexico.

The following environmental justice terminology developed by the Council on Environmental Quality (CEQ) is used in this analysis (CEQ 1997).

- Low-income population: A low-income population is determined based on annual statistical poverty thresholds developed by the USCB. In 2017, poverty level was based on a total income of \$12,752 for an individual and \$25,283 for a family of four (USCB 2017).
- 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% 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.
- Comparison population: For the purpose of identifying a minority population or a low-income population concentration, the comparison populations used in this study are the surrounding counties and the State of New Mexico.

Given the above data and BLM experience with the residents and communities surrounding the Proposed Action, the BLM FFO concludes that there are low-income, minority, and Native American populations

of concern (or “Environmental Justice Populations”), defined under EO 12898, that may be disproportionately impacted and potentially adversely impacted by activities resulting from development of the nominated lease parcels.

### 3.11.2 Environmental Impacts

Under the Proposed Action, the BLM would lease all of the nominated parcels that could result in future development of the parcels that may decrease quality of life-related values including clean air, water, noise, visual, traffic, safety, and fragmentation of habitable areas and otherwise have environmental justice related effects. For the majority of lease parcels, 1 well, with an associated projected disturbance of 4-6 acres can be anticipated if development is ever realized on the subject lease parcels. Parcels 24 and 25 could potentially see up to 4 wells, and 30 acres of disturbance. These parcels are located within the Counselor Chapter House, in areas not containing, or within 1 mile of dwellings. Some of the impacts to quality of life for environmental justice populations are relative to the other issues analyzed in this EA, and are based on previous BLM and FFO experience with the leasing and potential future development of parcels for oil and gas production. The determination of adverse and disproportionate impacts from specific actions are the assessment of the BLM, and should not be assumed to incorporate the position of specific, potentially impacted, environmental justice populations. The BLM realizes that additional impacts may be identified by local environmental justice populations as specific development locations and types are proposed within the leased parcels. As a result, Table 3.11.2 assesses only the impacts for the issues identified by BLM during internal scoping, at the lease sale stage. The BLM will continue to work with affected environmental justice populations to identify and address additional environmental justice issues as they arise.

**Table 3.11.2. Summary of conclusions from analysis of other issues and application to the Issue 8 analysis.**

ISSUE ANALYSIS CONCLUSIONS	ISSUE 8: QUALITY OF LIFE EFFECTS BASED ON ANALYSIS CONCLUSIONS OF OTHER ISSUES	ISSUE 8: IS THE EFFECT BASED ON ANALYSIS CONCLUSIONS OF OTHER ISSUES ADVERSE TO ENVIRONMENTAL JUSTICE POPULATIONS?	ISSUE 8: IS THE EFFECT BASED ON ANALYSIS CONCLUSIONS OF OTHER ISSUES DISPROPORTIONATE TO ENVIRONMENTAL JUSTICE POPULATIONS?
Issue 1: A 0.023% increase in NAAQS and VOC emissions in the subject EJ communities as a result of the Proposed Action.	While a nominal increase may be measurable, the perceptible human environment would not suffer as a result of a 0.023% increase in NAAQS or VOC emissions.	Yes. As with past and present actions, continued oil and gas development is the most prominent reasonably foreseeable future action affecting air quality in the FFO	Yes. Air quality is a regional resource and is felt by all communities in the area encompassed by the proposed action and development within the FFO, however, the fugitive dust (PM2.5 or PM10) impacts would be felt more by the local residents.
Issue 2: Potential increase in GHGs for the subject EJ communities, and global GHG emissions as a result of implementation of the Proposed Action	The increase in direct and indirect potential GHG emissions resulting from development of the nominated parcels would not produce climate change impacts noticeable to EJ communities.	Yes. Future development of the nominated lease parcels would contribute to increases in GHG emissions through both direct and indirect pathways.	No. The incremental contribution to global GHGs from the Proposed Action cannot be translated into effects on climate change globally or in the area of this site-specific action because it is currently not feasible to predict the net impacts on global or regional climate with any level of certainty.
Issue 5: Impact to groundwater quality and quantity	432 acre-feet are anticipated for use in potential future development. Cumulative	Yes. The water demand to complete any future wells that could be drilled from the	No. Groundwater resources are regional in nature. The total potential

ISSUE ANALYSIS CONCLUSIONS	ISSUE 8: QUALITY OF LIFE EFFECTS BASED ON ANALYSIS CONCLUSIONS OF OTHER ISSUES	ISSUE 8: IS THE EFFECT BASED ON ANALYSIS CONCLUSIONS OF OTHER ISSUES ADVERSE TO ENVIRONMENTAL JUSTICE POPULATIONS?	ISSUE 8: IS THE EFFECT BASED ON ANALYSIS CONCLUSIONS OF OTHER ISSUES DISPROPORTIONATE TO ENVIRONMENTAL JUSTICE POPULATIONS?
	withdrawal of water from the Fruitland formation from CBM wells may contribute to groundwater depletion.	nominated lease parcels is not expected to exceed past development demands within the San Juan Basin and is within the estimated use noted in the 2018 RFD scenario (Crocker and Glover 2018).	withdrawals would account for 0.01% of all water used in McKinley, Rio Arriba, Sandoval, and San Juan counties (based on water year 2010 usages). These include non EJ communities and are effected equally.
Issue 6: Impact to historic properties, including Native American traditional, cultural and religious concerns as well as known Traditional Cultural Properties (TCPs)	Dispersed development may create regional effects such as increased access, ground vibrations, noise, viewshed intrusions, etc. that have the potential to adversely affect historic properties. In many cases, past effects are difficult to quantify in existing data sets. Any impacts rising to the level of adverse effects would likely be mitigated through the Section 106 process.	Yes. Directly effects sites, though this is unlikely for any given action. Indirectly effects sites through viewshed or soundscape impacts -- either one facility close enough to have an impact or a number of more distant facilities with a cumulative impact.	Yes. Most if not all of the EJ communities are comprised of Native American communities claiming affiliation with TCPs associated with potential impacts from any increase in oil and gas development. While these TCP landscapes are regional resources, they hold special significance to these communities.

### 3.11.2.1 Cumulative Impacts

Residents and communities surrounding the proposed lease parcels would generally experience a disproportionate level of direct and indirect cumulative impacts due to their proximity to any future oil and gas development. Some of these effects would be temporary, such as the addition of project lighting or flaring to the landscape. Other effects, such as the addition of roads and oil and gas facilities to the region, would be relatively longer term, and would be in use for the lifetime of the projects.

The construction of new access roads near the proposed lease parcels could allow increased public access and traffic, and could potentially expose private property to vandalism. Based on ongoing consultation with residents and communities that may be disproportionately and adversely affected by actions resulting from this lease sale, BLM may develop lease stipulations, COAs, design features, and to address environmental justice concerns. Surface owner agreements would apply for private surface owners on split estate leases which could address any environmental justice concerns.

Impacts from GHG emissions are not anticipated to be disproportional to EJ populations surrounding the proposed lease parcels. Disproportional impacts to these populations may include issues related to air quality, visual resources, noise, and dark skies. Potential impacts to groundwater quantity and quality are also anticipated to be disproportional, and have the potential to be adverse, particularly to residents and communities surrounding lease parcels 11, 14, 15, 17, 24, 25, 33, 44, 45, where springs, water wells, residences, and communities are co-located. Scoping analysis identified that water is a critically valued resource by local residents and communities of the Navajo Nation and in the region of the proposed lease parcels. Impacts to local water wells could force residents to find other means of supplying water for domestic use. Any impacts to natural springs, including the Ojo Encino and Ojo Sandoval springs, could have adverse effects on traditional and ceremonial use of the springs and the historical character and importance of the springs to the surrounding region.

The surrounding (EJ) communities do not have additional policies or ordinances in place, above what the BLM can analyze, that would regulate certain impacts. Other communities, that do not meet the criteria for EJ, such as the City of Farmington, have defined ordinances for oil and gas development within their city limits that include rules for the maximum allowable height for pumping units, require sound mitigation paneling, and enforce noise restrictions that bar increases in the ambient noise level at a distance of 300 feet from the nearest occupied building (City of Farmington 2018). Additional protections like these are being analyzed in the Farmington Mancos-Gallup RMPA and EIS that is in development and anticipated to be completed in 2019.

Standard design features and project specific COAs would help to minimize potential effects that could be adverse and disproportionate. Lease stipulation BIA-1 would apply, and designate that no surface occupancy is allowed within 500 feet of any house, structure, or reservoir of water to reduce impacts from drilling and production activities. Noise would be kept at or below 48.6 dBA within 100 feet of all occupied residences surrounding the nominated lease parcels on BLM surface as described in NTL 04-2 FFO (BLM 2004). According to the CEQ (1997, pg. 10) guidelines, the identification of disproportional or adverse effects “...*should heighten agency attention to alternatives (including alternative sites), mitigation strategies, monitoring needs, and preferences expressed by the affected community or population.*”

Based on comments gained during scoping, the general preferences of the local communities near the proposed lease parcels would be to have no new oil and gas leasing until the Farmington Mancos-Gallup Draft RMPA and EIS is finished, tribal consultation has been conducted, and Section 106 requirements of the NHPA have been completed for the broader Chacoan landscape. The BLM must provide these affected environmental justice populations reasonable opportunities to identify adverse environmental impacts that may arise from the parcels in this lease sale, and should collaborate with the affected populations to determine methods and measures to alleviate any perceived adverse environmental impacts. The BLM cannot identify and mitigate any identified disproportionate and adverse effects unilaterally, but rather must do so in collaboration with the affected communities.

If future development occurs on the proposed lease parcels, identified and affected EJ populations will be given the opportunity to identify any environmental impacts that might arise from development that could have disproportionately high and adverse effects. Identified EJ populations that may be adversely and disproportionately impacted by development of leases sold in this lease sale will be engaged and be offered opportunities for meaningful involvement in alternatives development, mitigation strategies and monitoring needs, by the BLM and FFO.

## **CHAPTER 4. CONSULTATION AND COORDINATION**

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

### **4.1 ESA Consultation**

BLM FFO biologists have reviewed the proposed leasing and determined the proposed action would comply with threatened and endangered species management guidelines outlined in the 2002 Biological Assessment for the 2003 Farmington RMP (Consultation #2-22-01-I-389).

In 2014, the yellow-billed cuckoo was listed as threatened with proposed Critical Habitat. The proposed leasing action in this EA would have a “no effect” determination for this species due to a lack of nesting habitat within and adjacent to the nominated lease parcels for the yellow-billed cuckoo. The closest critical habitat for this species is approximately 18.6 miles south of the nearest parcel (parcel 43).

The New Mexico meadow jumping mouse was listed as endangered in 2014. The proposed leasing action in this EA would have a “no effect” determination for this species due to a lack of riparian habitat for the New Mexico meadow jumping mouse. The closest critical habitat for this species is approximately 28.8 miles southeast of the nearest parcel (parcel 10).

For Federally-listed fish species, a separate “effects determination” would be made at a site-specific project level to ensure that water used for drilling operations is properly permitted from existing legal sources (no new water depletions) and is in compliance with the ESA. Any new water depletion would likely require Section 7 consultation under the ESA. No further consultation with the US Fish and Wildlife Service (USFWS) is required at this stage.

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

## 4.2 Tribal Consultation

Tribal consultation for the proposed leasing action was initiated on a government to government basis by the BLM FFO to various Pueblos and tribes of New Mexico and Southern Colorado. A letter and map describing the proposed leasing and inviting consultation with the BLM FFO was sent via certified mail to each of the various Pueblos and tribes listed in Table 4.1 on October 12, 2018 with a request for response within 30 days of receipt.

**Table 4.1. Pueblos and Tribes Sent Consultation Requests from the BLM FFO.**

ENTITY	PERSON
Pueblo of Acoma	Governor Kurt Riley
All Pueblo Council of Governors	Governors
Becenti Chapter House	President Charles Long
Pueblo of Cochiti	Governor Dwayne Herrera
Counselor Chapter House	President Harry Domingo, Sr.
Eight Northern Indian Pueblo’s Council	Governors
Five Sandoval Indian Pueblos	Governors
Huerfano Chapter House	President Ben Woody, Jr.
Pueblo of Isleta	Governor J. Robert Benavides
Pueblo of Jemez	Governor Paul S. Chinana
Jicarilla Apache Tribal Council	President Levi Pesata
Kewa Pueblo	Governor Thomas Moquino, Jr.
Pueblo of Laguna	Governor Virgil A. Siow
Lake Valley Chapter House	President Tony Padilla, Jr.
Nageezi Chapter House	President Ervin Chavez
Pueblo of Nambe	Governor Phillip A. Perez
Navajo Nation	President Russell Begaye

ENTITY	PERSON
Ohkay Owingeh	Governor Peter Garcia, Jr.
Ojo Encino Chapter House	President George Werito
Pueblo of Picuris	Governor Craig Quanchello
Pueblo of Pojoaque	Governor Joseph M. Talachy
Pueblo Pintado Chapter House	President Rena Murphy
Pueblo of San Felipe	Governor Anthony Ortiz, Director Pinu' u Stout, Department of Natural Resources
Pueblo of San Ildefonso	Governor Perry Martinez
Pueblo of Sandia	Governor Richard Bernal
Pueblo of Santa Ana Tribal Historic Preservation Office	Tim Menchego
Pueblo of Santa Ana	Governor Glenn Tenorio
Pueblo of Santa Clara	Governor J. Michael Chavarria
Southern Ute Indian Tribe	Chairwoman Christine Baker-Sage
Pueblo of Taos	Governor Gilbert Suazo, Sr.
Ten Southern Pueblo Governor's Council	Governors
Pueblo of Tesuque	Governor Frederick Vigil
The Hopi Tribe	Chairman Timothy L. Nuvangyaoma
Torreón Chapter House	President David Rico
Ute Mountain Ute Tribe	Chairman Harold Cuthair
White Rock Chapter House	President Herbert Benally
Whitehorse Lake Chapter House	President Art L. Chavez
Pueblo of Zia	Governor Anthony Delgarito
Pueblo of Zuni	Governor Val Panteah, Sr.

Consultation requests for the FFO March 2019 Competitive Oil and Gas Lease Sale were received by the BLM from the Hopi Tribe and the Pueblo of San Felipe in response to the consultation letter sent by the BLM. No meetings have occurred but are expected to occur after issuance of the Cultural Resources literature review.

### 4.3 SHPO and THPO Consultation

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

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

lease sales and initial feedback from tribes, non-governmental organizations, and the public for this proposed undertaking, BLM is consulting with SHPO for parcels on nontribal lands using the procedures outlined in 36 CFR 800, not the Protocol. Consultation with the Navajo Nation THPO is also following 36 CFR 800.

Section 106 consultation for the entire set of parcels was initiated with the New Mexico SHPO and Navajo Nation THPO by letters sent December 11, 2018. The SHPO office has responded with a letter dated December 17, 2018 that they were in agreement with our consulting with them under 36 CFR 800 instead of under the protocol.

## CHAPTER 5. LIST OF PREPARERS

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

**Table 5.1. List of EA Preparers.**

NAME	AREA OF EXPERTISE	ORGANIZATION
Ryan Joyner	Planning and Environmental Coordinator	BLM FFO
Jillian Aragon	Project Manager	BLM FFO
Eric Creeden	Natural Resource Specialist	BLM FFO
Barbara Whitmore	Range Management Specialist	BLM FFO
Cy Rauworth	GIS Specialist	BLM FFO
Mathew Dorsey	GIS Specialist	BLM FFO
Dave Mankiewicz	Assistant Field Manager, Minerals	BLM FFO
Sarah Scott	Supervisory Natural Resource Specialist	BLM FFO
Doug McKim	Outdoor Recreation Planner	BLM FFO
Stanley Allison	Outdoor Recreation Planner	BLM FFO
Sherrie Landon	Paleontologist	BLM FFO
Erik Simpson	Archaeologist	BLM FFO
Geoffrey Haymes	Archaeologist	BLM FFO
Heather Perry	Natural Resource Specialist	BLM FFO
Chris Wenman	Natural Resource Specialist	BLM FFO
Whitney Thomas	Natural Resource Specialist	BLM FFO
Joe Hewitt	Geologist	BLM FFO
John Kendall	Threatened and Endangered Species Biologist	BLM FFO
David Mueller	Wildlife Biologist	BLM FFO
Kelly Christensen	Realty Specialist	BLM FFO
Monica Tilden	Realty Specialist	BLM FFO
Katie White Bull	Supervisory Realty Specialist	BLM FFO
Tony Gallegos	Mining Engineer	BLM FFO
Joel Hartmann	Geologist	BLM FFO
Richard Fields	Field Manager (Acting)	BLM FFO
Lola Henio	Tribal Liaison	BLM FFO

NAME	AREA OF EXPERTISE	ORGANIZATION
Mark Mathews	District Manager (Acting)	BLM FDO
Cynthia Herhahn	Archaeologist	BLM NMSO
Laura Hronec	Archaeologist	BLM NMSO
Lisa Bye	Fuels Specialist	BLM NMSO
Nathan Combs	Rangeland Management Specialist	BLM NMSO
Zoe Davidson	Botanist/Ecologist	BLM NMSO
Marikay Ramsey	Threatened and Endangered Species Biologist	BLM NMSO
Ross Klein	Natural Resource Specialist	BLM NMSO
Rebecca Hunt	Natural Resource Specialist – Minerals	BLM NMSO
Lillis Urban	Planning and Environmental Coordinator (Detail)	BLM NMSO
David Herrell	Hydrologist	BLM NMSO
Sharay Dixon	Air Specialist	BLM NMSO
Catie Brewster	Planning and Environmental Coordinator Assistant	BLM NMSO
Michael Johnson	Socio-Economic Zone Scientist	BLM NMSO
Jamie Young	NEPA Reviewer	SWCA Consultants
Paige Marchus	NEPA Reviewer	SWCA Consultants
Benjamin Gaddis	NEPA Facilitator and Reviewer	Gaddis Consulting, LLC

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**CHAPTER 7. APPENDICES**

**7.1. Appendix A. Nominated Parcels with Lease Stipulations for FFO March 2019  
Competitive Oil and Gas Lease Sale**

LEASE PARCEL	SURFACE OWNERSHIP	LEGAL DESCRIPTION	ACRES	LEASE STIPULATIONS
NM-201903-010	Private	T.0240N, R.0030W, NM PM, NM Sec. 032 SW; Rio Arriba County Farmington FO NMNM 86430 Formerly Lease No.	160.000	WO-ESA-7 WO-NHPA NM-11-LN F-4-TLS F-15-POD F-40-CSU F-41-LN
NM-201903-011	Navajo Nation	T.0200N, R.0050W, NM PM, NM Sec. 004 SW; McKinley County Farmington FO NMNM 100275 Formerly Lease No.	160.000	WO-ESA-7 WO-NHPA NM-11-LN NM-1-LN F-15-POD BIA-1 BIA-3 F-40-CSU
NM-201903-012	Navajo Nation	T.0200N, R.0050W, NM PM, NM Sec. 008 SW; McKinley County Farmington FO NMNM 100276 Formerly Lease No.	160.000	WO-ESA-7 WO-NHPA NM-11-LN NM-1-LN F-15-POD BIA-1 BIA-3
NM-201903-013	Navajo Nation	T.0200N, R.0050W, NM PM, NM Sec. 010 SE; McKinley County Farmington FO NMNM 100277 Formerly Lease No.	160.000	WO-ESA-7 WO-NHPA NM-11-LN NM-1-LN F-15-POD BIA-1 BIA-3
NM-201903-014	Navajo Nation	T.0200N, R.0050W, NM PM, NM Sec. 014 SE; McKinley County Farmington FO NMNM 100276 Formerly Lease No.	160.000	WO-ESA-7 WO-NHPA NM-11-LN NM-1-LN F-15-POD BIA-1 BIA-3
NM-201903-015	Navajo Nation	T.0200N, R.0050W, NM PM, NM Sec. 015 N2NWSE,N2S2NWSE; McKinley County Farmington FO NMNM 100277 Formerly Lease No.	30.000	WO-ESA-7 WO-NHPA NM-11-LN NM-1-LN F-15-POD BIA-1 BIA-3

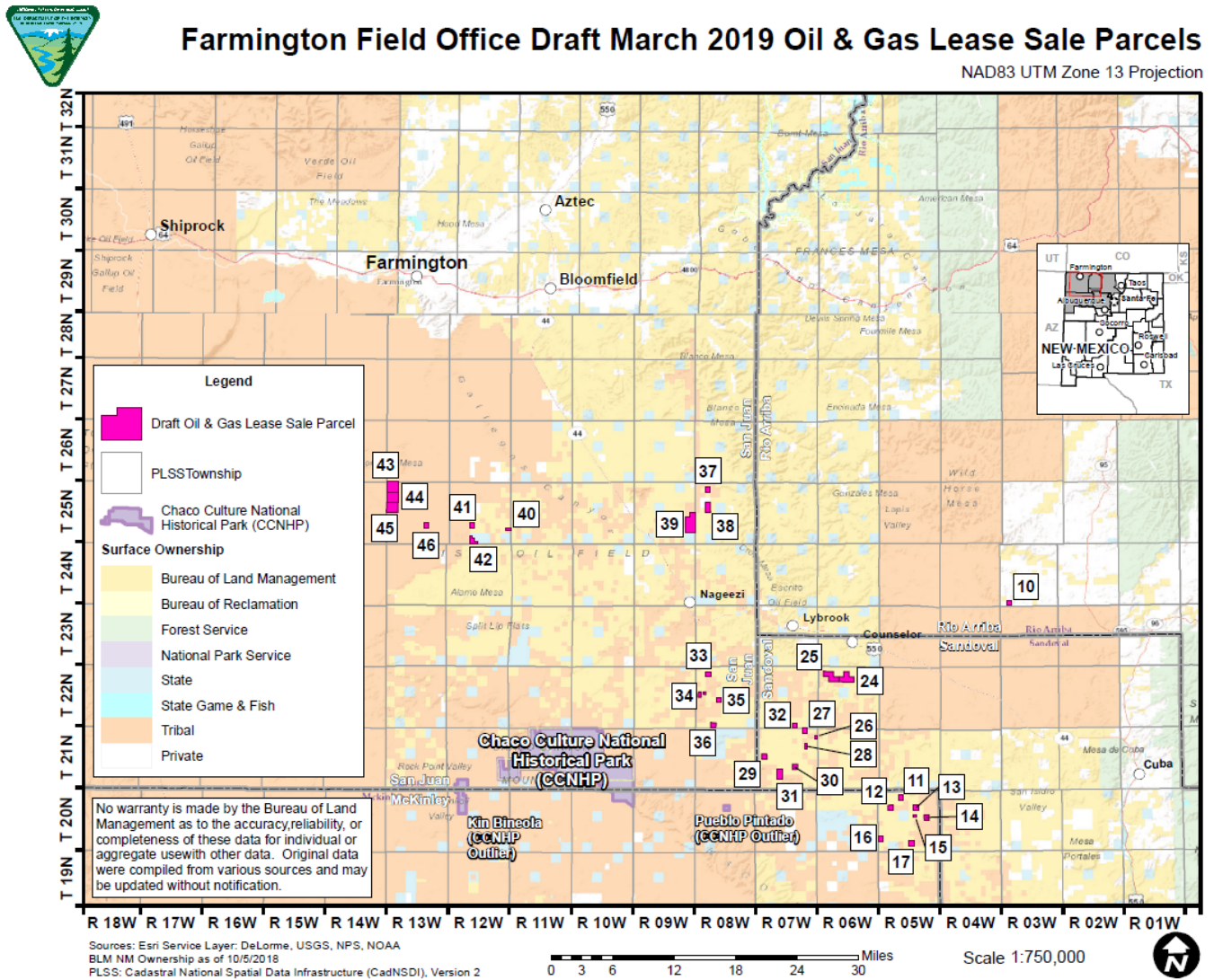
LEASE PARCEL	SURFACE OWNERSHIP	LEGAL DESCRIPTION	ACRES	LEASE STIPULATIONS
NM-201903-016	Navajo Nation	T.0200N, R.0050W, NM PM, NM Sec. 030 LOTS 3,4; 030 E2SW; McKinley County Farmington FO NMNM 100278 Formerly Lease No.	161.800	WO-ESA-7 WO-NHPA NM-11-LN NM-1-LN F-15-POD BIA-1 BIA-3 F-40-CSU
NM-201903-017	Navajo Nation	T.0200N, R.0050W, NM PM, NM Sec. 034 NW; McKinley County Farmington FO NMNM 100279 Formerly Lease No.	160.000	WO-ESA-7 WO-NHPA NM-11-LN NM-1-LN F-15-POD BIA-1 BIA-3 F-40-CSU
NM-201903-024	Navajo Nation	T.0220N, R.0060W, NM PM, NM Sec. 004 SE; 009 N2; 010 NW; Sandoval County Farmington FO NMNM 76833, NMNM 80480 Formerly Lease No.	640.000	WO-ESA-7 WO-NHPA NM-11-LN NM-1-LN F-15-POD BIA-1 BIA-3 F-39-NSO
NM-201903-025	Navajo Nation	T.0220N, R.0060W, NM PM, NM Sec. 005 SW; 006 SE; 008 N2; Sandoval County Farmington FO NMNM 76833 Formerly Lease No.	640.000	WO-ESA-7 WO-NHPA NM-11-LN NM-1-LN F-15-POD BIA-1 BIA-3 F-39-NSO
NM-201903-026	Navajo Nation	T.0210N, R.0070W, NM PM, NM Sec. 001 SESE; Sandoval County Farmington FO NMNM 100285 Formerly Lease No.	40.000	WO-ESA-7 WO-NHPA NM-11-LN NM-1-LN F-15-POD BIA-1 BIA-3 F-39-NSO
NM-201903-033	Navajo Nation	T.0220N, R.0080W, NM PM, NM Sec. 005 SW; San Juan County Farmington FO Formerly Lease No.	160.000	WO-ESA-7 WO-NHPA NM-11-LN NM-1-LN F-15-POD BIA-1 BIA-3 F-40-CSU

LEASE PARCEL	SURFACE OWNERSHIP	LEGAL DESCRIPTION	ACRES	LEASE STIPULATIONS
NM-201903-037	BLM	T.0250N, R.0080W, NM PM, NM Sec. 005 SW; San Juan County Farmington FO NMNM 047168 Formerly Lease No.	160.000	WO-ESA-7 WO-NHPA NM-1-LN NM-11-LN F-8-VRM F-15-POD F-40-CSU F-41-LN F-46-CSU
NM-201903-038	BLM / Private	T.0250N, R.0080W, NM PM, NM Sec. 017 W2; San Juan County Farmington FO NMNM 119284 Formerly Lease No.	320.000	WO-ESA-7 WO-NHPA NM-1-LN NM-11-LN F-8-VRM F-15-POD F-40-CSU F-41-LN F-46-CSU
NM-201903-039	BLM	T.0250N, R.0080W, NM PM, NM Sec. 017 W2; San Juan County Farmington FO NMNM 119284 Formerly Lease No.	1,122.850	WO-ESA-7 WO-NHPA NM-1-LN NM-11-LN F-8-VRM F-15-POD F-40-CSU F-41-LN F-46-CSU
NM-201903-040	Navajo Nation	T.0250N, R.0120W, NM PM, NM Sec. 025 N2SE; San Juan County Farmington FO NMNM 112961 Formerly Lease No.	80.000	WO-ESA-7 WO-NHPA NM-11-LN NM-1-LN F-15-POD BIA-1 BIA-3
NM-201903-041	Navajo Nation	T.0250N, R.0120W, NM PM, NM Sec. 028 NW; San Juan County Farmington FO NMNM 90483 Formerly Lease No.	160.000	WO-ESA-7 WO-NHPA NM-11-LN NM-1-LN F-15-POD BIA-1 BIA-3
NM-201903-042	Navajo Nation	T.0250N, R.0120W, NM PM, NM Sec. 033 SWNW, SW, SWSE; San Juan County Farmington FO NMNM 86493 Formerly Lease No.	240.000	WO-ESA-7 WO-NHPA NM-11-LN NM-1-LN F-15-POD BIA-1

LEASE PARCEL	SURFACE OWNERSHIP	LEGAL DESCRIPTION	ACRES	LEASE STIPULATIONS
				BIA-3
NM-201903-043	Navajo Nation	T.0250N, R.0130W, NM PM, NM Sec. 006 LOTS 1-14; 006 S2NE,SE; San Juan County Farmington FO NMNM 114380 Formerly Lease No.	709.290	WO-ESA-7 WO-NHPA NM-11-LN NM-1-LN F-15-POD BIA-1 BIA-3 F-40-CSU
NM-201903-044	Navajo Nation	T.0250N, R.0130W, NM PM, NM Sec. 007 LOTS 1-12; 007 E2; San Juan County Farmington FO NMNM 114380 Formerly Lease No.	712.280	WO-ESA-7 WO-NHPA NM-11-LN NM-1-LN F-15-POD BIA-1 BIA-3 F-40-CSU
NM-201903-045	Navajo Nation	T.0250N, R.0130W, NM PM, NM Sec. 018 LOTS 1-12; 018 E2; San Juan County Farmington FO NMNM 114380 Formerly Lease No.	714.600	WO-ESA-7 WO-NHPA NM-11-LN NM-1-LN F-15-POD BIA-1 BIA-3 F-40-CSU
NM-201903-046	Navajo Nation	T.0250N, R.0130W, NM PM, NM Sec. 027 NE; San Juan County Farmington FO NMNM 117150 Formerly Lease No.	160.000	WO-ESA-7 WO-NHPA NM-11-LN NM-1-LN F-15-POD BIA-1 BIA-3 F-40-CSU

## 7.2. Appendix B. Maps

Figure 7.1. Farmington Field Office March 2019 Competitive Oil and Gas Lease Sale Parcels





**7.3. Appendix C. FFO Lease Stipulation Summary**

STIPULATION	DESCRIPTION/PURPOSE
<p><b>F-4-TLS</b></p>	<p><b>TIMING LIMITATION STIPULATION IMPORTANT SEASONAL WILDLIFE HABITAT</b></p> <p>No surface use is allowed during the following time period. December 1 through March 31</p> <p>In addition, no surface use is allowed during the following time period to accommodate the migration of big game within the Lajara and Regina migration route. November 15 through March 31</p> <p>This stipulation does not apply to operation and maintenance of production facilities.</p> <p>On the lands described below: For the purpose of: Protection of important wildlife habitat (big game winter range).</p> <p>If circumstances or relative resource values change or if it can be demonstrated that oil and gas operations can be conducted without causing unacceptable impacts, this stipulation may be waived, excepted, or modified by the BLM Authorized Officer, if such action is consistent with the provisions of the Farmington Resource Management Plan, or if not consistent, through a land use plan amendment and associated National Environmental Policy Act analysis document. If the BLM Authorized Officer determines that the waiver, exception, or modification shall be subject to a 30-day public review period.</p> <p>Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes</p>
<p><b>F-8-VRM</b></p>	<p><b>VISUAL RESOURCE MANAGEMENT CLASS IV OBJECTIVES SPECIAL STIPULATION</b></p> <p>Surface occupancy or use is subject to the following operational constraints:</p> <p>Surface activities in this parcel are subject to Visual Resource Management (VRM) Class IV restrictions as set forth in BLM Manual 8400 – Visual Resource Management.</p> <p>Provide for management activities which require major modification of the existing character of the landscape. Activities <u>may attract attention, may dominate the view</u>, but are still mitigated. This may require additional mitigation methods such as special painting stipulations, site placement, and/or any other measures necessary for VRM Class IV objectives.</p> <p>The need for additional mitigation to meet VRM Class IV will be determined on a case-by-case basis for each proposed well.</p> <p>For the purpose of: Protecting Visual Resources</p>
<p><b>F-15-POD</b></p>	<p><b>PLAN OF DEVELOPMENT (POD) STIPULATION</b></p> <p>A plan of development (POD) for the entire lease must be submitted for review and approval, including NEPA analysis, by the Bureau of Land Management (BLM) authorized officer, prior to approval of development (APD, Sundry Notices) actions. The POD must indicate planned access to well facilities (roads, DOI-BLM-NM-F010-2016-0001-EA Page 96 of 99 pipelines, power lines), and the approximate location of well sites. Should it become necessary to amend the POD, the amendment must be approved prior to the approval of subsequent development action. Deviations from a current POD are not authorized until an amended POD has been approved by BLM.</p>
<p><b>F-40-CSU</b></p>	<p><b>CONTROLLED SURFACE USE STIPULATION SPECIAL CULTURAL VALUES AND/OR TRADITIONAL CULTURAL PROPERTIES</b></p> <p>Controlled surface use is allowed on the lands described below:</p> <p>For the purpose of: Protection of known cultural resource values and/or traditional cultural properties in areas not already within ACECs.</p> <p>If circumstances or relative resource values change or if it can be demonstrated that oil and gas operations can be conducted without causing unacceptable impacts, this stipulation may be waived, excepted, or modified by the BLM Authorized Officer, if such action is consistent with the Farmington Resource Management Plan, or if not consistent, through a land use plan amendment and associated National Environmental Policy Act analysis document. If the BLM Authorized Officer determines that the waiver, exception, or modification involves an issue of major public concern, the waiver, exception, or modification shall be subject to a 30-day public review period.</p> <p>Any changes to this stipulation will be made in accordance with the land use plan and or the regulatory provisions for such changes.</p>

STIPULATION	DESCRIPTION/PURPOSE
F-41-LN	<p><b>LEASE NOTICE - BIOLOGICAL SURVEY</b></p> <p>A biological survey may be required prior to any surface disturbing activity on BLM managed lands. Proposed activities may be subject to seasonal closures within sensitive species habitat. Federal land management agencies are mandated to manage special status species so they should not need to be listed under Endangered Species Act (ESA) in the future.</p>
F-46-CSU	<p><b>CONTROLLED SURFACE USES TIPULATION – TOPOGRAPHY</b></p> <p>Surface-disturbing such as well pad activities and related facilities are prohibited on slopes 15% and greater and/or side hill cuts of more than 3 feet vertical. Maximum grade on collector and arterial roads is 8% (except pitch grades not exceeding 300 feet in length and 10% in grade).</p> <p>For the purpose of: To maintain soil productivity, provide necessary protection to prevent excessive soil erosion on steep slopes, and to avoid areas subject to slope failure, mass wasting, piping, and/or having excessive reclamation challenges.</p> <p>If circumstances or relative resource values change or if the lessee demonstrates that operations can be conducted without causing unacceptable impacts, this stipulation may be excepted, modified or waived by the Authorized Officer if such action is consistent with the provisions of the applicable land use plan, or if not consistent through a planning amendment. An exception, modification, or waiver of this stipulation will require compliance with the National Environmental Policy Act and may be subject to a 15-day public review period. Any changes to this stipulation will be made in accordance with the land use plan and/or regulatory provisions for such changes. (For guidance on the use of this stipulation, see Bureau of Land Management Manuals 1624 and 3101 or Forest Service Manuals 1950 and 2820).</p> <p>The following is the criteria for exceptions, modifications and waivers:</p> <p>Exception: The authorizing officer may grant an exception to this condition for short distances (less than 300 feet and 10% in grade) for access roads if the operator submits a certified engineering and reclamation plan that clearly demonstrates impacts from the proposed actions are acceptable or can be adequately mitigated. This plan must include and demonstrate how the following will be accomplished:</p> <ul style="list-style-type: none"> <li>- Restoration of site.</li> <li>- Adequate control of surface runoff.</li> <li>- Protection of the site and adjacent areas from accelerated erosion, such as drilling, gullying, piping, and slope failure and mass wasting.</li> <li>- Protection of nearby water sources from sedimentation. Water quality and quantity will be in conformance with state and Federal water quality standards.</li> <li>- Completion of site-specific analysis of soil physical, chemical and mechanical (engineering) properties and behavior.</li> <li>- Timing of surface-disturbing activities these activities will not be conducted during extended wet periods.</li> <li>- Timing of reclamation as reclamation will not be allowed when soils are frozen.</li> </ul> <p>In addition, the operator must also provide an evaluation of past practices on similar terrain and be able to demonstrate success under similar conditions.</p>
NM-1-LN	<p><b>LEASE NOTICE – POTENTIAL, SUITABLE AND OCCUPIED HABITAT FOR SPECIAL STATUS PLANT SPECIES</b></p> <p>The lease contains potential, suitable and/or occupied habitat for special status plant species; therefore, special status plant species clearance surveys may be required prior to approving any surface disturbing activities within or adjacent to BLM Special Status Plant Species’ potential, suitable and occupied habitats.</p> <p>Survey requirements would include the following:</p> <p>Clearance surveys must be conducted by a qualified botanist as determined by the BLM.</p> <p>The area to be surveyed will include at a minimum the project area plus an additional 100 meters outside the project area.</p> <p>Clearance surveys will be conducted during the blooming season or the period in which the plant species is most easily detected as determined by the BLM.</p> <p>Based on the results of the survey, conditions of approval may be applied to land use authorizations and permits that fall within the area of direct/indirect impacts or affected habitat, as appropriate. Possible mitigation strategies may include, but are not limited to:</p>

STIPULATION	DESCRIPTION/PURPOSE
	<p>Avoidance/restriction of development such as locating the surface disturbance area away from the edge of occupied or suitable habitat and ideally outside of the area where indirect/direct impacts would occur;</p> <p>Minimizing the area of disturbance utilizing strategies such as but not limited to twinning, and utilizing existing disturbance and corridors;</p> <p>Dust abatement measures;</p> <p>Signs, fencing, and other deterrents to reduce human disturbance;</p> <p>Construction of well sites, roads and associated facilities outside of the blooming season;</p> <p>Specialized reclamation procedures such as, but not limited to,</p> <p>separating soil and subsoil layers with barriers to reclaim in the correct order,</p> <p>using a higher percentage of forbs in the reclamation seed mix to promote pollinator habitat,</p> <p>collection of seeds for sensitive plant species' genetic preservation, grow-out, and reclamation;</p> <p>Long term monitoring of indirect/direct impacts on the species and/or habitat;</p> <p>Qualified, independent third-party contractors to provide general oversight and assure compliance with project terms and conditions during construction;</p> <p>Non-native or invasive species monitoring and control in occupied and suitable habitat;</p> <p>Any other on-site habitat protection or improvements, known by best available science to be beneficial.</p> <p>On the following lands:</p>
<b>NM-11- LN</b>	<p><b>LEASE NOTICE – CULTURAL RESOURCES</b></p> <p>All development activities proposed under the authority of this lease are subject to compliance with Section 106 of the NHPA and Executive Order 13007. The lease area may contain historic properties, traditional cultural properties (TCPs), and/or sacred sites currently unknown to the BLM that were not identified in the Resource Management Plan or during the lease parcel review process. Depending on the nature of the lease developments being proposed and the cultural resources potentially affected, compliance with Section 106 of the National Historic Preservation Act and Executive Order 13007 could require intensive cultural resource inventories, Native American consultation, and mitigation measures to avoid adverse effects—the costs for which will be borne by the lessee. The BLM may require modifications to or disapprove proposed activities that are likely to adversely affect TCP's or sacred sites for which no mitigation measures are possible. This could result in extended time frames for processing authorizations for development activities, as well as changes in the ways in which developments are implemented.</p>
<b>WO-ESA-7</b>	<p><b>ENDANGERED SPECIES ACT- SECTION 7 CONSULTATION STIPULATION</b></p> <p>The lease area may now or hereafter contain plants, animals, or their habitats determined to be threatened, endangered, or other special status species. BLM may recommend modifications to exploration and development proposals to further its conservation and management objective to avoid BLM-approved activity that will contribute to a need to list such a species or their habitat. BLM may require modifications to or disapprove proposed activity that is likely to result in jeopardy to the continued existence of a proposed or listed threatened or endangered species or result in the destruction or adverse modification of a designated or proposed critical habitat. BLM will not approve any ground-disturbing activity that may affect any such species or critical habitat until it completes its obligations under applicable requirements of the Endangered Species Act as amended, 16 USC. 1531 et seq., including completion of any required procedure for conference or consultation.</p>
<b>WO-NHPA</b>	<p><b>CULTURAL RESOURCES AND TRIBAL CONSULTATION STIPULATION</b></p> <p>This lease may be found to contain historic properties and/or resources protected under the National Historic Preservation Act (NHPA), American Indian Religious Freedom Act, Native American Graves Protection and Repatriation Act, Executive Order 13007, or other statutes and executive orders. The BLM will not approve any ground-disturbing activities that may affect any such properties or resources until it completes its obligations (e.g., State Historic Preservation Officer (SHPO) and tribal consultation) under applicable requirements of the NHPA and other authorities. The BLM may require modification to exploration or development proposals to protect such properties, or disapprove any activity that is likely to result in adverse effects that cannot be successfully avoided, minimized, or mitigated.</p>

**7.4. Appendix D. BIA Lease Stipulation Summary**

STIPULATION	DESCRIPTION/PURPOSE
BIA-1	<p><b><u>NAVAJO REGION, BUREAU OF INDIAN AFFAIRS</u></b>  <b><u>SURFACE MANAGEMENT AGENCY LEASE STIPULATIONS</u></b>  <b><u>FOR FEDERAL OIL AND GAS LEASE OFFERING</u></b></p> <ol style="list-style-type: none"> <li>1. Lessee shall carry on all operations in a good and workmanlike manner in accordance with approved methods and practices.</li> <li>2. Lessees shall abide by and conform to appropriate provisions of Titles 25, 36, and 43 Code of Federal Regulations, and any and all other applicable regulations and manuals of the Secretary now or hereafter in force relative to surface leasing rights-of-way and as amended, and National Area Environmental Protection guidelines; the National Historic Preservation Act of 1966, as amended, Archaeological Resources Protection act, and American Indian Religious Freedom Act and other applicable laws, 30 BIA, 36 CFR 800 and 43 CFR 7.             <ol style="list-style-type: none"> <li>a. Prior to issuing any cultural clearances, the Lessee shall provide the necessary cultural clearances to the Bureau of Land Management, after consultation with the Navajo Nation Historic Preservation Department, P.O. Box 4950, Window Rock, AZ 86515, and provide copies of all historic preservation related documents associated with an undertaking. The Navajo Nation contracted Under Public Law 93-638 the Navajo Area Archaeology Office.</li> <li>b. Prior to entry upon the land or the disturbance of the surface thereof for drilling or other purposes, lessee shall submit a development plan for surface use to the Area Manager, Farmington Resource Area, Bureau of Land Management, 6251 College Blvd, Suite A, Farmington, NM 87402. An Environmental Analysis will be made by the Bureau of Land Management in consultation with the BIA Navajo Region Office for the purpose of ensuring proper protection of the surface, the natural resources, the environment and existing improvements and for assuring timely reclamation of disturbed lands. Upon completion of said environmental analysis, the Oil and Gas Field Manager shall notify Lessee of the conditions to which the proposed surface disturbing operations will be subject. (Note: Prior to operations beginning; Lessee shall furnish a copy of its development plan and Bureau of Land Management conditions to the BIA. The BIA reserves the right to require site specific archaeological surveys and environmental reviews on tracts selected for development prior to giving concurrence to proposed actions(s). The BIA will consult with the Navajo Nation prior to concurring in such actions.)</li> </ol> </li> <li>3. The Lessee shall not use or permit to be used any part of said leased land for any unlawful conduct or purpose whatsoever. Lessee will not use or permit to be used any part of said leased land for the manufacture, sale, gift, transportation, or storage of intoxicating liquors, beverages or drugs. In the event any representative of Lessee or its contractor or subcontractor, employed in connection with the operations on the lease premises shall be responsible for any of the unlawful acts described in this clause, Bureau of Land Management shall give Lessee information as to such violation(s) with a copy of the notice to BIA and Navajo Nation. Lessee shall immediately take steps to cure the violations, including the termination or transfer of such employee. (25 CFR 162; 18 U.S.C. Sections 1151, 1154 and 1156, as amended.)</li> <li>4. Except as otherwise stated herein, copies of correspondence and notices shall be mailed to the Bureau of Indian Affairs in care of the Regional Director, Navajo Region Office, Attention: Branch of Real Estate Services, Bureau of Indian Affairs, P.O. Box 1060, Gallup, NM 87305-1060; and to the Navajo Nation in care of the President, Navajo Nation, Attention: Navajo Tribal Minerals Department, P.O. Box 1910, Window Rock, AZ 86515.</li> </ol> <p><b><u>THE NAVAJO NATION STIPULATIONS</u></b></p> <ol style="list-style-type: none"> <li>1. The surface ownership of lands contained in this lease may be all or partly managed by the Navajo Nation. Site specific rights-of-way clearances and/or inventories may be required prior to entry upon the surface for operation of the lease holdings. Prior contact with the Navajo Nation will be required prior to operations beginning. All applicable laws of the Navajo Nation (including tax laws, water codes, requirements of Environmental Protection Administration, etc.) shall be complied with the Lessee.</li> </ol>

STIPULATION	DESCRIPTION/PURPOSE
	<p>2. The Navajo Nation requires a copy of complete exploration and development data (drilling logs, seismic data, etc.) obtained by the Lessee on the subject lands will be provided to the Navajo nation at no cost. All materials data will be held confidential as described in 43 CFR 3162.8.</p>
<p><b>BIA-1 (Continued)</b></p>	<p>3. Navajo grazing rights to the surface of the lands so leased shall be protected, and the Nation's rights respecting the use of water shall be unimpaired.</p> <p>4. Lessee shall not obtain water for use in drilling from Indian-owned wells, tanks, springs, or stockwater reservoirs without prior written permission from the Navajo Nation. Lessee shall not drill any water wells for its use without prior written consent of the Navajo Nation and the Regional Director.</p> <p>5. Lessee shall compensate the Navajo nation and its grazing permittees (if any), for all surface use(s) as well as damages to crops, buildings, and other improvements of surface landowner, including loss of grazing lands, occasioned by the Lessee's operations except the Lessee's control. Compensation for surface use shall be negotiated by Lessee and the Navajo Nation and will be based upon the duration of activity on the land.</p> <p>6. Lessee shall not drill any well within 500 feet of any house, structure, or reservoir of water without the Navajo Nation's written consent.</p> <p>7. Lessee shall bury all pipelines crossing tillable lands below plow depth unless other arrangements are made with the Navajo Nation.</p> <p>8. Upon the request of the Navajo Nation or if so required by the Regional Director or his authorized representative, and under the director of the Field Manager, Bureau of Land Management, the Lessee shall condition any well drilled which does not produce oil or gas in paying quantities, but which is capable of producing water satisfactorily for domestic, agricultural, or livestock use by the Navajo Nation. Otherwise, after the expiration or termination of the lease, the Lessee shall remove all pumping equipment installed by Lessee at any well.</p>
<p><b>BIA-3</b></p>	<p><b><u>NAVAJO REGION, BUREAU OF INDIAN AFFAIRS</u></b>  <b><u>SURFACE MANAGEMENT AGENCY LEASE STIPULATIONS</u></b>  <b><u>FOR FEDERAL OIL AND GAS LEASE OFFERING</u></b></p> <p>The pipeline will be so installed that it will not interfere with the construction and/or development of the area for agricultural purposes and/or operation of same in connection with the Navajo Indian Irrigation Project (NIIP). Any changes or relocations found to be necessary during said construction and/or development will be accomplished at the Company's expense.</p> <p>In addition, the pipeline will be buried to a depth of 48 inches and any permanent metering and production equipment installed at the actual site will conform to "no well and/or production equipment within irrigable fields of the Navajo Indian Irrigation Project will exceed two feet above natural surface elevation and be adequately barricade for safety." Further, if crops are planted prior to accomplishment of the pipeline work, surface damages must be negotiated with Navajo Agricultural Products Industry.</p>

## **7.5. Appendix E. Lease Notations**

### **7.5.1. Parcel NM-201903-015**

Note: Surface disturbance within this lease may be limited to the eastern half and northern portions of the lease. Sewage treatment ponds for the community of Ojo Encino are located on the western half of this lease.

### **7.5.2. Parcel NM-201903-037**

Note: The Cluster Federal #1 (API: 30-045-25974) well is located within this lease. While this well has been plugged and the well pad has been reclaimed, it has not yet received approval for final abandonment from the Bureau of Land Management and Bureau of Indian Affairs.

### **7.5.3. Parcel NM-201903-033**

Note: This lease is located on Navajo Nation surface within and adjacent to the general footprint of the nationally designated West-wide Energy Corridor (WWEC). The 2003 Farmington Resource Management Plan (RMP) established guidelines for development within the WWEC on BLM managed surface (BLM 2003, pg. 2-11), however there are no WWEC development restrictions on Navajo Nation surface. Any surface disturbance proposed outside of this lease and within the WWEC on BLM managed surface would follow guidelines from the 2003 Farmington RMP which could include siting disturbance outside of the WWEC.

## 7.6. Appendix F. Phases of Oil and Gas Development

### 7.6.1. Construction Activities

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

Next, heavy equipment including but not limited to bulldozers, graders, front-end loaders, and/or track hoes are used to construct at a minimum the pad, but other features, as needed for development, may include, but is not limited to an access road, reserve pit, pipeline, and/or fracturing pond. Cut and fills may be required to level the pad or road surfaces. If a reserve pit is authorized, it would be lined using an impermeable liner or other lining mechanism (i.e. bentonite or clay) to prevent fluids from leeching into the soil. Access roads may have cattle guards, gates, drainage control, or pull-outs installed, among a host of other features that may be necessary based on the site specific situation. Long-term surfaces are typically dressed with a layer of crushed rock or soil cemented. Construction materials come from a variety of sources. Areas not needed for long-term development (i.e. portions of the pipeline or road right-of-way) are reclaimed by recontouring the surface and establishing vegetation.

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

### 7.6.2. Drilling Operations

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

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

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

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

### 7.6.3. Completion Operations

Once a well has been drilled, completion operations would begin once crews and equipment are available. Well completion involves setting casing to depth and perforating the casing in target zones.

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

### 7.6.4. Hydraulic Fracturing

Hydraulic fracturing (HF) is one technological key to economic recovery of oil and gas that might have been left by conventional oil and gas drilling and pumping technology. It is a formation stimulation practice used to create additional permeability in a producing formation, thus allowing gas to flow more readily toward the wellbore. Hydraulic fracturing can be used to overcome natural barriers, such as naturally low permeability or reduced permeability resulting from near wellbore damage, to the flow of fluids (gas or water) to the wellbore (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. The proppant is needed to “prop” open the fractures once the pumping of fluids has stopped. Once the fracture has initiated, additional fluids are pumped into the wellbore to continue the development of the fracture and to carry the proppant deeper into the formation. The additional fluids are needed to maintain the downhole pressure necessary to accommodate the increasing length of opened fracture in the formation.

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

This process increases the flow rate and volume of reservoir fluids that move from the producing formation into the wellbore. The fracturing fluid is typically more than 99% water and sand, with small amounts of readily available chemical additives used to control the chemical and mechanical properties of the water and sand mixture (see discussion about Hazardous and Solid Wastes below).

Because the fluid is composed mostly of water, large volumes of water are usually needed to perform hydraulic fracturing. However, in some cases, water is recycled or produced water is used.

Chemicals serve many functions in hydraulic fracturing, from limiting the growth of bacteria to preventing corrosion of the well casing. Chemicals are needed to insure the hydraulic fracturing job is effective and efficient. The fracturing fluids used for shale stimulations consist primarily of water but also include a variety of additives. The number of chemical additives used in a typical fracture treatment



varies depending on the conditions of the specific well being fractured. A typical fracture treatment uses very low concentrations of between three and 12 additive chemicals depending on the characteristics of the water and the shale formation being fractured. Each component serves a specific, engineered purpose. The predominant fluids currently being used for fracture treatments in the shale gas plays are water-based fracturing fluids mixed with friction-reducing additives, also known as slickwater (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 formation.

Some soils and geologic formations contain low levels of radioactive material. This naturally occurring radioactive material (NORM) emits low levels of radiation, to which everyone is exposed on a daily basis. When NORM is associated with oil and natural gas production, it begins as small amounts of uranium and thorium within the rock. These elements, along with some of their decay elements, notably Radium-226 and Radium-228, can be brought to the surface in drill cuttings and produced water. Radon-222, a gaseous decay element of radium, can come to the surface along with the shale gas. When NORM is brought to the surface, it remains in the rock pieces of the drill cuttings, remains in solution with produced water, or, under certain conditions, precipitates out in scales or sludges. The radiation is weak and cannot penetrate dense materials such as the steel used in pipes and tanks.

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 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 formation. If the fracturing

of the well is considered to be a “non-routine” fracture for the area, the BLM would always be onsite during those operations as well as when abnormal conditions develop during the drilling or completion of a well.

### 7.6.5. Production Operations

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

Workovers may be performed multiple times over the life of the well. Because 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; HF materials; production products (natural gas, condensates, produced water); fuels and lubricants; pipeline materials; combustion emissions; and miscellaneous materials. Table 7.3 includes some of the common wastes (hazardous and nonhazardous) that are produced during oil and gas development.

**Table 7.3. Common Wastes Produced During Oil and Gas Development.**

PHASE	WASTE	
Construction	Domestic wastes (i.e. food scraps, paper, etc.)	
	Excess construction materials	Woody debris
	Use lubricating oils	Paints
	Solvents	Sewage
	Drilling muds, including additives (i.e. chromate and barite) and cuttings; Well drilling g, 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)	

PHASE	WASTE
Abandonment / Reclamation	Construction materials
	Decommissioned equipment
	Contaminated soil

## 7.7. Appendix G. Social Cost of Carbon

A protocol to estimate what is referenced as the “social cost of carbon” (SCC) associated with Greenhouse Gas (GHG) emissions was developed by a federal Interagency Working Group (IWG), to assist agencies in addressing Executive Order (E.O.) 12866, which requires federal agencies to assess the cost and the benefits of proposed regulations as part of their regulatory impact analyses. The SCC is an estimate of the economic damages associated with an increase in carbon dioxide emissions and is intended to be used as part of a cost-benefit analysis for proposed rules. As explained in the Executive Summary of the 2010 SCC Technical Support Document “the purpose of the [SCC] estimates...is to allow agencies to incorporate the social benefits of reducing carbon dioxide (CO<sub>2</sub>) emissions into cost-benefit analyses of regulatory actions that have small, or ‘marginal,’ impacts on cumulative global emissions.” Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866 February 2010 (withdrawn by E.O. 13783). While the SCC protocol was created to meet the requirements for regulatory impact analyses during rulemakings, there have been requests by public commenters or project applicants to expand the use of SCC estimates to project-level National Environmental Policy Act (NEPA) analyses.

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

Further, the NEPA does not require a cost-benefit analysis (40 C.F.R. § 1502.23), although NEPA does require consideration of “effects” that include “economic” and “social” effects (40 C.F.R. 1508.8(b)). Without a complete monetary cost-benefit analysis, which would include the social benefits of the proposed action to society as a whole and other potential positive benefits, inclusion solely of an SCC cost analysis would be unbalanced, potentially inaccurate, and not useful in facilitating an authorized officer’s decision. Any increased economic activity, in terms of revenue, employment, labor income, total value added, and output, that is expected to occur with the proposed action is simply an economic impact, rather than an economic benefit, inasmuch as such impacts might be viewed by another person as negative or undesirable impacts due to potential increase in local population, competition for jobs, and concerns that changes in

population will change the quality of the local community. Economic impact is distinct from “economic benefit” as defined in economic theory and methodology, and the socioeconomic impact analysis required under NEPA is distinct from cost-benefit analysis, which is not required.

Finally, the SCC, protocol does not measure the actual incremental impacts of a project on the environment and does not include all damages or benefits from carbon emissions. The SCC protocol estimates economic damages associated with an increase in carbon dioxide emissions - typically expressed as a one metric ton increase in a single year - and includes, but is not limited to, potential changes in net agricultural productivity, human health, and property damages from increased flood risk over hundreds of years. The estimate is developed by aggregating results “across models, over time, across regions and impact categories, and across 150,000 scenarios” (Rose et al. 2014). The dollar cost figure arrived at based on the SCC calculation represents the value of damages avoided if, ultimately, there is no increase in carbon emissions. But the dollar cost figure is generated in a range and provides little benefit in assisting the authorized officer’s decision for project level analyses. For example, in a recent environmental impact statement, Office of Surface Mining estimated that the selected alternative had a cumulative SCC ranging from approximately \$4.2 billion to \$22.1 billion depending on dollar value and the discount rate used. The cumulative SCC for the no action alternative ranged from \$2.0 billion to \$10.7 billion. Given the uncertainties associated with assigning a specific and accurate SCC resulting from oil and gas production that could occur once the oil and gas lease is issued, and that the SCC protocol and similar models were developed to estimate impacts of regulations over long time frames, this environmental assessment (EA) quantifies direct and indirect GHG emissions and evaluates these emissions in the context of U.S. and State/County GHG emission inventories as discussed in the Affected Environment and Environmental Impacts section of the EA.

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

#### References Cited

Rose, Steven et al. 2014. Understanding the Social Cost of Carbon: A Technical Assessment. Electric Power Research Institute.

E.O. 13783. Executive Order 13783 of March 28, 2017. Presidential Executive Order on Promoting Energy Independence and Economic Growth.

**7.8. Appendix H BLM Sensitive Species**

Species	Common Name	Farmington	Taos	Rio Puerco	Socorro	Las Cruces	Roswell
<b>Amphibians</b>							
<i>Anaxyrus (Bufo)microscaphus</i>	Southwestern (Arizona)toad	None	None	Potential	Verified	Verified	None
<i>Lithobates (Rana) pipiens</i>	Northern leopard frog	Verified	Verified	Verified	Verified	None	None
<b>Amphibians - Watch</b>							
<i>Craugastor (Eleutherodactylus) augustilatrans</i>	Eastern barking frog	None	None	None	None	Verified	Verified
<i>Gastrophryne olivacea</i>	Western narrowmouthtoad	None	Potential	None	None	Verified	None
<i>Lithobates (Rana) blairi</i>	Plains leopard frog	Verified	Verified	None	None	Verified	Verified
<i>Lithobates yavapaiensis</i>	Lowland Leopard Frog	None	None	None	Potential	Potential	None
<b>Arthropods</b>							
<i>Danaus plexippus plexippus</i>	Monarch Butterfly	Verified	Verified	Verified	Verified	Verified	Verified

Species	Common Name	Farmington	Taos	Rio Puerco	Socorro	Las Cruces	Roswell
<i>Lytta mirifica</i>	Anthony Blister Beetle	None	None	None	None	Verified	None
<i>Ochlodes yuma anasazi</i>	Yuma Skipper	None	Verified	None	None	None	None
<b>Arthropods - Watch</b>							
<i>Bombus occidentalis</i>	Western Bumble Bee	Verified	Verified	Verified	Verified	Verified	Verified
<i>Deronectes (Stictotarsus)</i>	Bonita Diving Beetle	None	None	None	None	None	Potential
<b>Birds</b>							
<i>Aimophila boterii</i>	Botteri's Sparrow	None	None	None	None	Verified	None
<i>Ammodramus bairdii</i>	Baird's Sparrow	None	None	None	None	Verified	None
<i>Ammodramus savannarum</i>	Arizona Grasshopper	None	None	None	None	Verified	None
<i>Athene cunicularia</i>	Western Burrowing Owl	Verified	Verified	Verified	Verified	Verified	Verified
<i>Anthus spragueii</i>	Sprague's Pipit	None	None	None	Potential	Verified	Verified
<i>Antrostomus arizonae</i>	Mexican Whip-poor-will	Potential	Verified	Verified	Verified	Verified	Potential
<i>Calcarius mccownii</i>	McCown's Longspur	None	Potential	None	Potential	Verified	Verified

<b>Species</b>	<b>Common Name</b>	<b>Farmington</b>	<b>Taos</b>	<b>Rio Puerco</b>	<b>Socorro</b>	<b>Las Cruces</b>	<b>Roswell</b>
<i>Calcarius ornatus</i>	Chestnut-collared Longspur	Potential	Verified	None	Verified	Verified	Verified
<i>Gymnorhinus</i>	Pinyon Jay	Verified	Verified	Verified	Verified	Verified	Verified
<i>Toxostoma bendirei</i>	Bendire's Thrasher	Verified	Potential	Verified	Verified	Verified	Potential