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Cluster 45

Lybrook A03-2208

Lease Number NMNM 90468, NMNM 55836, and NM 116065

Lybrook D12-2208

Lease Number NMNM 48989A

Lybrook E11-2208

Lease Number NMNM 48989A and NM 048989

Lybrook E12-2208

Lease Number NMNM 48989A

Lybrook E15-2208

Lease Number ST NM B-10894 and ST NM VA-1119

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It is the mission of the Bureau of Land Management to sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations.

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ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
AADT	Average Annual Daily Traffic
ACHP	Advisory Council on Historic Preservation
APD	Application for Permit to Drill
AQI	Air Quality Index
AUM	animal unit month
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BOP	blowout preventer
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	Methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COA	Conditions of Approval
EA	Environmental Assessment
Ecosphere	Ecosphere Environmental Services, Inc.
EIS	Environmental Impact Statement
Encana	Encana Oil & Gas (USA) Inc.
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FFO	Farmington Field Office
GHG	greenhouse gases
GIS	geographic information system
HAP	hazardous air pollutants
LAC	La Plata Archaeological Consultants
MBTA	Migratory Bird Treaty Act

MLA	Mineral Leasing Act
NAAQS	National Ambient Air Quality Standard
NATA	National Scale Air Toxics Assessments
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMAAQS	New Mexico Ambient Air Quality Standards
NMDOT	New Mexico Department of Transportation
NMPIF	New Mexico Partners in Flight
NMPM	New Mexico Principal Meridian
NO_2	nitrogen dioxide
NO_x	nitrous oxides
NPA	National Programmatic Agreement
NRHP	National Register of Historic Places
NW	northwest
O_3	ozone
ONGARD	Oil and Natural Gas Administration and Revenue Database
Pb	lead
PFYC	Potential Fossil Yield Classification
PL	Public Law
PM_{10}	particulate matter between 2.5 and 10 micrometers in diameter
$PM_{2.5}$	particulate matter less than 2.5 micrometers in diameter
PRMP	Proposed Resource Management Plan
RMP	Resource Management Plan
RFD	reasonable foreseeable development
ROD	Record of Decision
ROW	right-of-way
RPFO	Rio Puerco Field Office
SDA	Specially Designated Area
SHPO	State Historic Preservation Officer
SO_2	sulfur dioxide
TUA	temporary use area
USC	United States Code
USDI	United States Department of Interior
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VOC	volatile organic compounds

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1. PURPOSE AND NEED FOR ACTION

1.1 Background

Encana Oil & Gas (USA) Inc. (Encana) is proposing to develop the Lybrook A03-2208, Lybrook D12-2208, Lybrook E11-2208, Lybrook E12-2208, and the Lybrook E15-2208 well pads and associated access roads and well-tie pipelines (Cluster 45) in San Juan County, New Mexico. Encana has filed Applications for Permit to Drill (APDs) with the United States Department of the Interior (USDI) Bureau of Land Management (BLM) Farmington Field Office (FFO) to drill two wells each on the Lybrook E15-2208, Lybrook E11-2208, and the Lybrook A03-2208 well pads and one well each on the Lybrook D12-2208 and Lybrook E12-2208 well pads.

The proposed Lybrook E11-2208 well pad would be located on lease, and the pad and access road would be permitted through the APD process and the well-tie pipeline by a right-of-way (ROW) grant from the BLM/FFO. Encana has also applied for ROW grants with the BLM/FFO to construct the proposed Lybrook A03-2208, Lybrook D12-2208, Lybrook E12-2208, and the Lybrook E15-2208 well pads and associated access roads and well-tie pipelines.

Surface disturbance activities associated with drilling the wells would include construction of five well pads, new and upgraded access roads, and subsurface well-tie pipelines. The proposed action would be located on BLM-managed lands and would access federal minerals administered by the BLM/FFO. The proposed action would be located approximately 5.5 miles to 9.2 miles southwest of Lybrook, New Mexico.

1.2 Purpose and Need for Action

The purpose of the proposed action is to provide Encana with reasonable access to BLM-managed lands to develop their federal mineral leases (Lease Numbers NMNM 90468, NMNM 55836, NM 116065, NMNM 48989A, NM 048989, ST NM B-10894 and ST NM VA-1119) to construct the five proposed well pads, access roads, well-tie pipelines, and drill the eight proposed wells.

The need for the action is BLM's responsibility under the Mineral Leasing Act (MLA) of 1920, as amended (30 United States Code [USC] 181 et seq.), to respond to the APDs and ROW applications. The MLA authorizes the BLM to issue oil and gas leases for the exploration of mineral resources and permit the development of those leases. The need for the action is also established by the BLM's authority under the Title V of the Federal Land Policy and Management Act, as amended (43 USC 1761-1771) and Section 28 of the MLA (43 USC 185).

1.3 Decision to be Made

Based on the information in this Environmental Assessment (EA), the BLM/FFO will decide whether to approve the APDs and ROW grants, and if so, under what terms and conditions. In compliance with the MLA, the decision to be made is how resource development should occur. Under the National Environmental Policy Act (NEPA), as amended (Public Law [PL]. 91-90, 42 USC 4321 et seq.), the BLM/FFO must determine if there are any significant environmental impacts associated with the

proposed action warranting further analysis in an Environmental Impact Statement (EIS). The BLM/FFO Field Manager is the responsible officer who will decide one of the following:

- To approve the proposed APDs and ROW grants with design features as submitted
- To approve the proposed APDs and ROW grants with additional mitigations
- To analyze the effects of the proposal in an EIS
- To deny the APDs and ROW grants

1.4 Conformance with Applicable Land Use Plan(s)

Pursuant to 40 Code of Federal Regulations (CFR) 1508.28 and 1502.21, this EA incorporates the information and analysis contained in the 2003 Farmington Proposed Resource Management Plan (PRMP)/Final Environmental Impact Statement (FEIS) (USDI/BLM 2003a). The proposed action would be in conformance with the oil and gas leasing and development management actions in the Resource Management Plan (RMP)/Record of Decision (ROD) signed December 2003 and updated in December 2003 (USDI/BLM 2003b). The proposed action would be in conformance with the 2003 RMP/ROD that states, to the extent possible, new ROWs would be located within or parallel to existing ROWs or corridors to minimize resource impacts (USDI/BLM 2003b, page 2-11).

The PRMP/FEIS and ROD are available for review at the FFO in Farmington, New Mexico, or electronically at http://www.nm.blm.gov/ffo/ffo_home.html. This project EA addresses site-specific resources and/or impacts that are not covered within the PRMP/FEIS, as required by the NEPA.

Oil and gas development is recognized as an appropriate use of public lands in the FFO planning area (USDI/BLM 2003b). The RMP adheres to the federal mandates contained in the Energy Policy and Conservation Action (42 USC 6217) and Executive Order 13212, that direct federal land managing agencies to expedite the production of the federal mineral estate for the development of reliable domestic sources of energy (USDI/BLM 2003b, pages 1 and 11). The proposed project would not be in conflict with any local, county, or state plans.

1.5 Relationship to Statutes, Regulations, or Other Plans

Encana would comply with all applicable federal, state, and local laws and regulations, as well as obtain the necessary permits for the installation and operation of the wells, access roads, and pipelines. These laws and regulations include, but are not limited to:

- Antiquities Act of 1906, as amended (PL 52-209; 16 USC 431-433)
- American Indian Religious Freedom Act of 1978 (PL 95-431; 92 Stat. 469; 42 USC 1996)
- Archaeological Resources Protection Act of 1979 (PL 96-95; 93 Stat. 721; 16 USC § 470aa et seq.), as amended (PL 100-555; PL 100-588)
- Bald and Golden Eagle Protection Act of 1940, as amended (PL 86-70, PL 87-884, PL 92-535, PL 95-616; USC 668-668d)
- Clean Air Act, as amended (PL 88-206; 42 USC § 7401 et seq.)
- Clean Water Act, as amended (PL 107-303; 33 USC § 1251, et seq.)
- Colorado River Salinity Control Act, as amended (PL 93-320; 7 CFR Part 702)

- Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (PL 96-510; 42 USC § 9601; 40 CFR Part 307)
- Endangered Species Act (ESA) of 1973 (PL 93-205; 16 USC § 1531 et seq.)
- Executive Order 11988 Floodplain Management
- Executive Order 11990 Protection of Wetlands
- Executive Order 12898 Environmental Justice
- Executive Order 13007 Indian Sacred Sites
- Executive Order 13112 Invasive Species
- Executive Order 13186 Responsibilities of Federal Agencies to Protect Migratory Birds
- Migratory Bird Treaty Act (MBTA) of 1918, as amended (16 USC §§ 703-712; 50 CFR Part 21)
- Native American Graves Protection and Repatriation Act of 1990 (PL 101-601; 104 Stat. 3048; 25 USC 3001; 43 CFR Part 10)
- New Mexico Oil and Gas Act (1978 § 70-2-1–38) and related statutory provisions
- Paleontological Resources Preservation Act as part of the Omnibus Public Land Management Act (PL 111-011, Title VI, Subtitle D)
- Safe Drinking Water Act, as amended (PL 93-523; 42 USC 300F-300-9), 40 CFR Parts 144 and 147)
- Section 106 of the National Historic Preservation Act (NHPA) of 1966 (PL 89-665; 80 Stat. 915; 16 USC 470 et seq.), as amended (implemented under regulations of the Advisory Council on Historic Preservation, 36 CFR Part 800)

1.6 Scoping, Public Involvement, and Issues

The Council on Environmental Quality (CEQ) defines scoping as “an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action alternative” (40 CFR 1501.7). Scoping is the process by which the BLM solicits internal and external input on the issues, impacts, and potential alternatives that will be addressed in an EIS or EA. As outlined in the BLM NEPA Handbook, it is optional for the BLM to conduct external scoping on actions analyzed by an EA (USDI/BLM 2008, Section 6.3.2).

The BLM/FFO Interdisciplinary Team was integrally involved in the internal scoping to identify potential issues, understand the proposal, develop the purpose and need, and develop a range of alternatives.

For the purpose of BLM NEPA analysis, an “issue” is a point of disagreement, debate, or dispute with a proposed action based on some anticipated environmental effect. Preliminary issues are frequently identified during the development of the proposed action through scoping.

1.6.1 Issues to be Analyzed

The following issues were identified as potential issues of concern by the Interdisciplinary Team during internal scoping:

- How would the proposed action affect air quality in the area?

- How would the proposed action affect soil resources?
- How would the proposed action affect upland vegetation and noxious weeds?
- How would the proposed action affect wildlife, BLM special management species, and migratory birds?
- How would the proposed action affect cultural resources?
- How would the proposed action affect paleontological resources?
- How would the proposed action affect travel and transportation?
- How would the proposed action affect livestock grazing?

As outlined in the BLM NEPA Handbook, it is optional for the BLM to conduct external scoping on actions analyzed by an EA (USDI/BLM 2008, Section 6.3.2). External scoping was conducted through posting this project on the BLM/FFO's online NEPA log. The log is located on the BLM New Mexico website (http://www.blm.gov/nm/st/en/prog/planning/nepa_logs.html). The log contains a list of proposed and approved actions in the FFO. The public is encouraged to provide comments or request information on projects listed in the logs.

1.6.2 Issues Considered but Not Analyzed

CEQ regulations (40 CFR § 1501.7) state that the lead agency shall identify and eliminate from detailed study the issues that are not important or that have been covered by prior environmental review, narrowing the discussion of these issues in the document to a brief presentation of why they would not have a significant effect on the human or natural environment or providing a reference to their coverage elsewhere.

The Interdisciplinary Team identified the following resources during internal scoping as potential issues of concern that would not be significantly impacted.

Groundwater

Stimulation (i.e., hydraulic fracturing or "fracking") is a process used to maximize the extraction of underground resources by allowing oil or natural gas to move more freely from the rock pores to production wells that bring the oil or gas to the surface. Fluids, commonly made up of water (99 percent) and chemical additives (1 percent), are pumped into a geologic formation at high pressure during hydraulic fracturing (USEPA 2004). Chemicals added to stimulation fluids may include friction reducers, surfactants, gelling agents, scale inhibitors, acids, corrosion inhibitors, antibacterial agents, and clay stabilizers. When the fracking pressure exceeds the rock strength, the fluids open or enlarge fractures that typically extend several hundred feet away from the well bore and may occasionally extend up to 1,000 feet from the well bore. After the fractures are created, a propping agent (usually sand) is pumped into the fractures to keep them from closing when the pumping pressure is released. After fracturing is completed, a portion of the injected fracturing fluids returns to the wellbore and is recovered for future fracturing operations or disposal (USEPA 2004). Stimulation techniques have been used in the United States since 1949 and in the San Juan Basin since the 1950s. Over the last 10 years, advances in multi-stage and multi-zone hydraulic fracturing have allowed development of gas fields that previously were uneconomic, including the San Juan Basin.

Hydraulic fracturing is a common process in the San Juan Basin and applied to nearly all wells drilled. The producing zone targeted by the proposed action is well below any underground sources of drinking water. The Mancos Shale formation is also overlain by a continuous confining layer. The geological confining layer is the Lewis Shale formation that is located above both the Mancos Shale and Mesaverde formations and provides an impermeable layer that isolates the Mancos Shale and Mesaverde formations from both identified sources of drinking water and surface water. On average, total depth of the proposed well bore would be about 5,000 feet below the ground surface. Fracturing in the Basin Mancos formation is not expected to occur above depths of 4,000 feet below the ground surface. Fracturing could possibly extend into the Mesaverde formation overlying the Basin Mancos; however, the formation has not been identified as an underground source of drinking water based on its depth and relative high levels of total dissolved solids. No impacts to surface water or freshwater-bearing groundwater aquifers are expected to occur from hydraulic fracturing of the proposed wells.

Threatened and Endangered Species

No federally listed species with the potential to occur in San Juan County or potential habitats for federally listed species were observed within the proposed analysis area. Furthermore, no designated critical habitat for any federally listed species occurs within the proposed analysis area. Water used for well drilling and completions would be sourced from a permitted private water well (Point of Diversion Number SJ 2105). No new water depletions would result from the proposed action. The BLM/FFO reviewed and determined that the proposed action is in compliance with listed species management guidelines outlined in the September 2002 Biological Assessment (Cons. No. 2-22-01-I-389) (USDI/BLM 2002). No further consultation with the U.S. Fish and Wildlife Service (USFWS) is required.

Traditional Cultural Properties

For the proposed action, identification of Native American Religious Concerns was limited to reviewing existing, published, and unpublished literature (Brugge 1993; Kelly et al. 2006; Van Valkenburgh 1941, 1974); the site-specific Class III survey report prepared for the proposed action; and a review by the BLM's cultural resources program regarding the presence of traditional cultural properties identified through ongoing BLM tribal consultation efforts. There are currently no known remains that fall within the purview of the Native American Graves Protection and Repatriation Act of 1990 (25 USC 3001) or the Archaeological Resources Protection Act (16 USC 470) within the analysis area. The proposed action would not impact any known traditional cultural properties, prevent access to sacred sites, prevent the possession of sacred objects, or interfere with or hinder the performance of traditional ceremonies and rituals pursuant to the American Indian Religious Freedom Act of 1978 (42 USC 1996) or Executive Order 13007.

2. DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

2.1 Alternative A: No Action

The BLM NEPA Handbook (H-1790-1; USDI/BLM 2008) states that for EAs on externally initiated proposed actions, the no action alternative is generally to reject the proposal or deny the application. This option is provided in 43 CFR 3162.3-2 (h) (2). This alternative would deny the approval of the APDs and ROW grants, and the current land and resource uses would continue in the area. The no action alternative provides a useful baseline for comparison of environmental effects (including cumulative effects) and demonstrates the consequences of not meeting the need for the action.

2.2 Alternative B: Proposed Action

Encana is proposing development of the Cluster 45 well pads, well-tie pipelines, and roads to access the mineral estate administered by the BLM/FFO. The proposed action would be located in San Juan County, New Mexico, south of Lybrook and U.S. Highway 550. A vicinity map is provided as Figure 1 in Appendix A. Figure 2 shows the proposed action on the Lybrook NW, New Mexico U.S. Geological Survey 7.5-minute topographic map. Figure 3 displays the proposed action on the Lybrook NW, New Mexico 2010 aerial photograph (see Appendix A). Photographs of the proposed action components are also provided in Appendix A. Legal descriptions of the proposed action components are listed in Table 2-1.

Table 2-1. Legal description for the proposed action components surface locations

Component		Legal Description
Lybrook A03-2208	Well pad	NE ¼ of Section 3 and the NW ¼ of Section 2, Township 22 North, Range 8 West
	Access road and pipeline	Sections 2 and 3, Township 22 North, Range 8 West
Lybrook D12-2208	Well pad	NW ¼ of Section 12 and the SW ¼ of Section 1, Township 22 North, Range 8 West
	Access road and pipeline	Sections 11 and 12, Township 22 North, Range 8 West
Lybrook E11-2208	Well pad	NW ¼ of Section 11, Township 22 North, Range 8 West
	Access road	Section 11, Township 22 North, Range 8 West
	Pipeline	Sections 1, 2, and 11, Township 22 North, Range 8 West
Lybrook E12-2208	Well pad	NW ¼ of Section 12, Township 22 North, Range 8 West
	Access road and pipeline	Sections 11 and 12, Township 22 North, Range 8 West
Lybrook E15-2208	Well pad	NW ¼ of Section 15, Township 22 North, Range 8 West
	Access road	Sections 14 and 15, Township 22 North, Range 8 West
	Pipeline	Sections 11, 14, and 15, Township 22 North, Range 8 West

Note: NE = northeast, NW = northwest; SW = southwest

Construction of the proposed action would require temporary use areas (TUAs). Table 2-2 lists the TUA locations, purpose, and size.

Table 2-2. Temporary use area locations, purpose, and size

Component	Station	Purpose	Size (acres)
Lybrook D12-2208	Access road 7+92 to 10+12	Steep slope	0.48
	Access road 44+93 to 47+15	Wash crossing	0.46
Lybrook E11-2208	Well-tie pipeline 11+76 to 14+87	Staging area	0.69
Lybrook E12-2208	Well-tie pipeline 7+92 to 10+12	Hillside cut	0.48
	Well-tie pipeline 44+14 to 47+14	Wash crossing	0.76
Lybrook E15-2208	Access road 9+14 to 15+83	Range improvement (silt trap and access)	1.27

Table 2-3 lists the well-tie pipeline and access road lengths and the dimensions of the well pads that are part of the proposed action. The proposed Lybrook E11-2208 well pad would be on lease and would be permitted through the APD process. The remaining components would be permitted by ROW grants from the BLM/FFO. The table includes land status for each project component.

Table 2-3. Permitted rights-of-way for the proposed action

Name	Type of Right-of-Way	Bureau of Land Management (feet)
Lybrook A03-2208	Well pad	430 x 400
	Access road	884
	Pipeline	920
Lybrook D12-2208	Well pad	400 x 400
	Access road	4,862
	Pipeline	4,106
Lybrook E11-2208[1]	Well pad	460 x 400
	Access road	81
	Pipeline	12,371
Lybrook E12-2208	Well pad	430 x 400
	Access road	5,132
	Pipeline	1,257
Lybrook E15-2208	Well pad	460 x 400
	Access road	7,841
	Pipeline	9,912

[1] On lease well pad and road would be permitted through the Application for Permit to Drill process.

Activities associated with the proposed project would include construction of the access roads and well pads; upgrading existing roads; drilling, stimulation, and completion of the proposed wells; installation of surface facilities necessary to produce the wells; and installation of pipelines to transport natural gas to markets. These activities are detailed below.

Construction

Construction for the access roads and well pads would take approximately 1 to 2 weeks per location. Table 2-4 provides a summary of proposed disturbance that would occur under the proposed action. Detailed descriptions are provided in the following paragraphs.

Table 2-4. Summary of surface disturbance for the proposed action

	Total Disturbance (acres)			New Disturbance (acres)	Long-term Disturbance (acres)		
Name	**Well Pad**	**Pipeline/ Road (1)**	**Total**	**Total**	**Well Pad**	**Pipeline/ Road[1]**	**Total**
Lybrook A03-2208	6.08	1.1	7.2	7.2	1.6	0.4	2
Lybrook D12-2208	5.74	6.3	12.1	8.9	1.6	2.4	4
Lybrook E11-2208	6.43	11.5	18.5	13.7	1.6	-	1.6
Lybrook E12-2208	6.08	5.6	11.7	10.3	1.6	2.6	4.2
Lybrook E15-2208	6.43	10.1	17.4	14.1	1.6	1.1	2.7
Total			**66.9**	**54.2**			**14.5**

[1] Where pipeline and roads parallel, the construction corridor is 50 feet wide; for access roads, the construction corridor is 30 feet wide; for pipelines on Bureau of Land Management (BLM) managed land, the construction corridor is 40 feet wide.

Temporary Use Area (TUA) disturbance is included in the total.

Also refer to Figure 2 in Appendix A.

Drilling of the proposed Lybrook A03-2208 wells would require constructing a 430-foot by 400-foot well pad with a 50-foot-wide construction zone around the perimeter for a disturbance of approximately 6.08 acres. Maximum cut would be approximately 18.1 feet at corner 5, and the maximum fill would be approximately 16.9 feet at corner 2. To access the well pad, Encana would construct approximately 884-feet of road. Encana would also construct and operate a proposed well-tie pipeline approximately 920 feet in length. The pipeline and access road would parallel for approximately 801 feet. Where the pipeline and access road are parallel, the construction width would be 50 feet. The remaining 83 feet of the road would be constructed in a 30-foot ROW, and the remaining 119 feet of pipeline would be constructed in a 40-foot ROW. Total surface disturbance for the proposed project would be 7.2 acres. After interim reclamation, 2 acres would remain long-term disturbance.

Drilling of the proposed Lybrook D12-2208 well would require constructing a 400-foot by 400-foot well pad with a 50-foot-wide construction zone around the perimeter for a disturbance of approximately 5.74 acres. Maximum cut would be approximately 5.4 feet at corner 3, and the maximum fill would be approximately 6.2 feet at corner 6. To access the site, Encana would construct an approximately 4,862-foot access road, which would follow an existing two-track for its entire length. The proposed well-tie pipeline would be approximately 4,106 feet in length and would parallel the proposed access road for the

majority of its length. Where the pipeline and access road are parallel, the construction width would be 50 feet (including the road width). The remaining 756 feet of the road would be constructed in a 30-foot-wide ROW. Construction of the proposed Lybrook D12-2208 access road and well-tie pipeline would require two TUAs. Total surface disturbance for the proposed project would be approximately 12.1 acres. After interim reclamation, 4 acres would remain long-term disturbance.

Drilling of the proposed Lybrook E11-2208 wells would require constructing a 460-foot by 400-foot well pad with a 50-foot-wide construction zone around the perimeter for a disturbance of approximately 6.43 acres. Maximum cut would be approximately 13.3 feet at corner 3, and the maximum fill would be approximately 14.7 feet at corner 5. The well-tie pipeline would be approximately 12,371 feet in length and is located on an existing two-track road. The pipeline would be permitted within a 40-foot wide ROW on BLM-managed lands. To access the site, Encana would construct an approximately 81 feet access road within a 30-foot wide corridor. Total surface disturbance of the proposed project would be approximately 18.5 acres. After interim reclamation, 1.6 acres would remain disturbed.

Drilling of the proposed Lybrook E12-2208 well would require constructing a 430-foot by 400-foot well pad with a 50-foot-wide construction zone around the perimeter for a disturbance of approximately 6.08 acres. Maximum cut would be approximately 12.7 feet at corner 3, and the maximum fill would be approximately 2.8 feet at corner 6. To access the well pad, Encana would construct or upgrade a 5,132-foot access road. Approximately 1,293 feet would be new construction and 3,839 feet of the proposed access would upgrade an existing two-track. Encana would also construct and operate a proposed well-tie pipeline, which would be approximately 1,257 feet in length. The proposed well-tie pipeline would parallel the proposed access road. Total construction width of the proposed access road and pipeline would be 50 feet. Construction of the proposed Lybrook E12-2208 access road and well-tie pipeline would require two TUAs. Total surface disturbance for the proposed project would be 11.7 acres. After interim reclamation, approximately 4.2 acres would remain long-term disturbance.

Drilling of the proposed Lybrook E15-2208 wells would require constructing a 460-foot by 400-foot well pad with a 50-foot-wide construction zone around the perimeter for a disturbance of approximately 6.43 acres. Maximum cut would be approximately 9.7 feet at corner 2, and the maximum fill would be 9 foot at corner 5. To access the well pad, Encana would construct/upgrade a 7,841 feet of access road. New road construction would include approximately 2,452 feet to access the pad and approximately 1,161 feet to access an existing pond near the proposed well pad to obtain material for construction (total 3,613 feet). The remaining 4,228 feet would upgrade an existing resource road. The new access road would be constructed within a 30-foot-wide corridor except where parallel to the proposed pipeline. Encana would also construct and operate a proposed well-tie pipeline, which would be approximately 9,912 feet in length. The proposed well-tie pipeline would parallel the proposed access for 2,452 feet. Where parallel, total construction width of the proposed access road and pipeline would be 50 feet (2.8 acres). The remaining 7,460 feet of pipeline would be constructed within a 40-foot-wide ROW (6.9 acres). Encana is also proposing to install a large 410-foot by 50-foot silt trap north of the proposed pipeline/access road ROW to obtain soil and create a potential livestock water source for BLM range allottees. The range improvements would result in 1.27 acres of disturbance (0.47 acre for the pond and 0.79 acre for the access). Total surface disturbance for the proposed project would be 17.4 acres. After interim reclamation, 2.7 acres would remain long-term disturbance (1.6 acres for the pad, 1.1 acres for the new access).

Drilling and Completions

After access road and well pad construction is complete, Encana would mobilize a drilling rig to drill the wells from each pad. During drilling operations, equipment on the site would include:

- The drilling rig
- Stockpiles of drill pipe and casing
- A closed-loop system and aboveground tanks for collecting cuttings and fluids
- Mud shakers to separate the cuttings from the fluids
- Generators to provide power to the drill rig
- Office trailers equipped with sleeping quarters for essential personnel

Drilling operations would be conducted in compliance with all Federal Onshore Oil and Gas Orders, all applicable Federal and State of New Mexico rules and regulations, and BLM Notice to Lessees. The proposed wells would be horizontal wells targeting the Basin Mancos. The proposed wells would be drilled to a vertical depth greater than 5,000 feet and then horizontally drilled.

Using a freshwater-based drilling mud system, surface casing would be set to an approximate measured depth of 500 feet. After the surface casing is installed, it would be cemented in place by pumping cement down the casing, circulating the cement back up the outside of the casing to create a cement sheath around the entire casing, and then tested to ensure the quality and integrity of the cement. Prior to drilling below the surface casing, a blowout preventer (BOP) would be installed on the surface casing, and both the BOP and surface casing would be pressure tested for integrity. After installation and testing of the BOP, a string of intermediate casing would be installed. The intermediate casing would be cemented and then tested to ensure the quality and integrity of the cement.

After cementing the intermediate string, a synthetic oil-based drilling mud system would be used to drill the horizontal portion of the wellbore. Additives may be mixed with the mud system to achieve borehole stability, minimize possible damage to geologic formations, provide adequate viscosity to carry the drill cuttings out of the wellbore, and reduce downhole fluid losses.

After drilling the wellbore to its final depth, a production liner would be run and secured into place utilizing an external swell packer system. The production liner provides additional isolation of the wellbore and creates a pathway for natural gas or liquids to travel from the formation to the surface.

After the production liner has been secured into place, the drilling rig would be removed, and a completion rig moved to the site. The completion rig would run a completions string of the same size, weight, and grade as the production liner into the wellbore to tie-in to the liner/liner hanger, providing a secondary barrier during completions that protects intermediate casing from pressures needed to pump into the formation. During completions activities, the well pads would have completions rigs, completions command centers, steel storage tanks, pump trucks and transports, blending and mixing facilities, and related ancillary completions equipment.

Completing the wells would require hydraulic fracturing—the process of injecting water, sand, and a small amount of fluid additives into the wellbore under very high pressure to fracture the formation and release the oil. A series of charges would be set through the producing interval in the horizontal portion of

the wellbore to perforate the production liner and casing and create small fractures in the target formation. A fluid and sand mixture would be injected at high pressure into the formation to create cracks or fractures; the sand would act as a proppant to keep the fractures open and allow oil to move more efficiently into the wellbore. The fracturing process would be done in stages, with each stage continuing in the same manner along the horizontal portion of the wellbore, using a series of plugs to isolate portions of the well that were previously fractured. After all of the stages are completed, the plugs would be drilled out to allow gas or oil to flow to the wellhead.

Completions would be designed with nitrogen foam to minimize water usage and improve fluid recoveries post-completions. Water would be sourced from a private water well located in the SW/NE ¼ of Section 32, of Township 25 North, Range 9 West, New Mexico Principal Meridian (NMPM). This well is permitted by the State of New Mexico. The well has been assigned the Point of Diversion Number SJ 2105 by the New Mexico Office of the State Engineer. Water would be stored on-site in steel storage tanks (up to 15).

Drilling activities would occur continuously for approximately 2 weeks per well and would require on-site supervision 24 hours a day. Completions activities are expected to take 1 to 3 weeks per well.

Production

Production facilities on the well pads would consist of wellheads, metering units, separators, aboveground condensate and produced water tanks (two tanks per well), and compressors. If artificial lift is required, conventional pumping units (pump jacks) and/or gas lift systems would be installed.

Tank batteries would be placed within corrugated steel secondary containment berms and would be sized to contain a minimum of 110 percent of the storage capacity of the largest tank within the berm. Containment berms would include an impermeable liner attached to the rings and laid under the tanks. All loading lines would be placed inside the containment berm or would have secondary containment vessels.

Installation of production equipment would take 2 to 3 weeks per well pad. Production facilities would be in place for the life of the wells, which are anticipated to be 30 to 50 years.

Pipeline Installation

The proposed well-tie pipelines would be up to a 6-inch outside diameter buried steel pipelines with a maximum allowable operating pressure of 500 pounds per square inch gauge. Related aboveground appurtenances that would be installed within the pipeline workspace would include cathodic protection equipment, futures, and block valves with blowdowns.

The trench line, or ditch, would be excavated and sloped in accordance with Occupational Safety and Health Administration specifications. The cover from top of pipe to ground level would be a minimum of 36 inches through typical soil and rock and a minimum depth of 48 inches at road crossings. Excavated material would be stockpiled at the edge of the workspace.

The trenching operation would be followed by pipe installation that would include stringing, bending for horizontal or vertical angles in the alignment, welding pipe segments together, inspection, coating joints to prevent corrosion, and lowering into the trench. Backfilling would begin after a section of the pipe has been successfully placed in the ditch and final inspection has been completed.

Cleanup activities would be initiated as soon as practicable after backfilling activities have been completed. The pipelines would be seeded with the seed mix and rates provided in the Reclamation Plan attached to the APDs for the wells.

Construction and well-tie pipeline installation activities would take 4 to 6 weeks per pipeline, and reclamation activities would take 1 to 2 weeks per well-tie pipeline. The pipelines and related aboveground appurtenances would be in place for the life of the wells, which are anticipated to be 30 to 50 years.

Interim Reclamation

After production facilities are installed at the pads, the size of the well pads would be reduced to the minimum surface area needed for production facilities and future operations. Interim reclamation procedure would follow the Bare Soil Reclamation Procedure and the reclamation plan submitted with the APD and ROW Applications. Interim reclamation would consist of grading and re-contouring the portion of the well pad not needed for production facilities/future operations to blend with adjacent natural surroundings as much as practicable, covering with salvaged topsoil material, and seeding to re-establish vegetation. Seed mixtures and rates would be in accordance with the Reclamation Plan for each proposed location. Sediment and erosion control measures would be installed as necessary. Interim reclamation would reduce the disturbed area to approximately 1.6 acres per pad. The proposed pipeline ROWs would be reclaimed where they do not overlap the access roads. Approximately 14.5 acres associated with well operation and access would not be reclaimed.

Interim reclamation activities would be initiated within 90 days after completion of the well or 120 days of the spud date and would take 2 to 4 weeks per well pad.

Abandonment and Final Reclamation

Upon abandonment of the wells, the wellbores would be plugged with cement, and the production facilities would be removed. Federal and State of New Mexico standards would be followed, and Encana would provide the BLM with technical and environmental aspects of the final plugging and abandonment and reclamation procedures. The well pads and access roads would be graded and re-contoured to blend with adjacent natural surroundings, covered with salvaged topsoil material, and seeded to re-establish vegetation. Sediment and erosion control measures would be installed as necessary. Final reclamation procedure would follow the Bare Soil Reclamation Procedure and the reclamation plan submitted with the APD and ROW Applications.

2.2.1 Design Features

All areas of proposed surface disturbance were inspected in the field to ensure that potential impacts to natural resources would be minimized through the implementation of design features. For a detailed description of the design and construction practices associated with the proposed action, refer to the APDs and plats in Appendix B. For the proposed action, standard and project-specific design features include but are not limited to the following:

- Roads will be maintained in the same or better condition as what existed prior to the commencement of operations. Road maintenance will continue until final abandonment and reclamation of the well locations.
- Dust emissions will be controlled on the roads and locations, as necessary, with the application of dust suppressants (e.g., magnesium chloride) and/or water.
- The well pad access roads will be designed and constructed as Resource Roads in accordance with the BLM Gold Book Standards (USDI/USDA 2007) and BLM 9113-1 (Roads Design Handbook) and BLM 9113-2 (Roads National Inventory and Condition Assessment Guidance and Instructions Handbook). Construction will include ditching, draining, installing culverts, crowning and capping or sloping and dipping the roadbed, and installing pullouts, as necessary, to provide a well-constructed and safe road.
- All BLM/FFO cultural resources stipulations will be followed as indicated in the Cultural Resource Records of Review, attached to the Conditions of Approval (COA) in the APD/ROW as the case may be. These stipulations may include, but are not limited to temporary or permanent fencing or other physical barriers, monitoring of earth-disturbing construction, reduction and/or specific construction avoidance zones, and employee education. All employees, contractors, and sub-contractors of the project will be informed by the project proponent that cultural sites are to be avoided by all personnel, personal vehicles, and company equipment. All employees, contractors, and sub-contractors of the project will also be informed that it is illegal to collect, damage, or disturb cultural resources and that such activities are punishable by criminal and/or administrative penalties under the provisions of the Archaeological Resources Protection Act. In the event of a discovery during construction, the project proponent will immediately stop all construction activities in the immediate vicinity of the discovery and then immediately notify the archaeological monitor, if present, or the BLM. The BLM will then evaluate or cause the site to be evaluated. Should a discovery be evaluated as significant (e.g., National Register of Historic Places [NRHP], Native American Graves Protection and Repatriation Act, Archaeological Resources Protection Act), it will be protected in place until mitigating measures can be developed and implemented according to guidelines set by the BLM.
- Prior to construction, pipeline and road ROWs will be staked at 100- to 200-foot intervals.
- Grazing permittees will be notified when construction is scheduled to begin. All hazards to livestock will be fenced or contained.
- All project activities will be confined to permitted areas only.
- Where pipeline construction parallels or crosses public roads, warning signs will be placed to alert motorists of construction. Safety measures will also be implemented along the construction workspace by either using the topsoil or subsoil piles or strung pipe as a barrier. Trenches left open at road crossings will be fenced with orange safety fence, and barricades will be installed, if needed.
- Clearing, removal of topsoil, and grading will be limited to the minimum area required for safe and efficient construction.
- Trees larger than 3 inches in diameter will be cut at ground level and delimbed. Stumps will be cut as close to the ground as possible. Stumps and root balls will be hauled to an approved

disposal site or stockpiled at the edge of the well pad and buried in the cut slopes of the pad during interim reclamation.

- Trees smaller than 3 inches in diameter, slash, and brush will be chipped, shredded, or mulched and will then be incorporated into the topsoil for later use in interim reclamation.
- Remaining brush will be brush-hogged or scalped at ground level prior to ground disturbance.
- Topsoil will be segregated and stockpiled at the edge of the workspace. Topsoil is defined as the top 6 inches of soil. Vehicle/equipment traffic will be prevented from crossing topsoil stockpiles.
- If a location becomes prone to wind or water erosion, Encana will take appropriate measures to prevent topsoil loss. Such measures may include using tackifiers or water to wet the topsoil stockpile to create a crust across the exposed soil to prevent soil loss.
- Culverts will be installed, as needed, along the new and upgraded access roads from the well pads to the arterial route. Culverts will be sized and installed in accordance with BLM Gold Book standards (USDI/USDA 2007) and BLM 9113-1 (Roads Design Handbook) and BLM 9113-2 (Roads National Inventory and Condition Assessment Guidance and Instructions Handbook).
- A closed-loop system will be used for each location. Cuttings will be stored on-site in aboveground storage tanks. Cuttings will be disposed at an approved waste disposal facility.
- The closed-loop system storage tanks will be sized to ensure confinement of all fluids and will provide sufficient freeboard to prevent uncontrolled releases.
- A 20-millimeter-thick liner will be installed under tanks, pumps, ancillary facilities, and truck loading/unloading areas associated with the closed-loop system.
- Drilling fluids will be stored on-site in aboveground storage tanks. Upon termination of drilling operations, the drilling fluids will be recycled and transferred to other permitted closed-loop systems or returned to the vendor for reuse, as practical. Residual fluids will be disposed of at an approved waste disposal facility.
- The water-based solution that flows back to the surface during and after completion operations will be placed in storage tanks on the location. Flowback water will be confined to a storage tank for a period not to exceed 90 days after initial production and will be disposed of at an approved waste disposal facility.
- Any spills of non-freshwater fluids will be immediately cleaned up and removed to an approved disposal site.
- Self-contained chemical toilets will be provided for human waste disposal. The toilet holding tanks will be pumped, as needed, and the contents thereof disposed of in an approved sewage disposal facility. Toilets will be on-site during all operations.
- Garbage, trash, and other waste materials will be collected in a portable, self-contained, and fully-enclosed trash container during drilling and completion operations. The accumulated trash will be removed, as needed, and will be disposed of at an authorized sanitary landfill. No trash will be buried or burned on location.
- Immediately after removal of the drilling rig, all debris and other waste materials not contained in the trash container will be cleaned up and removed from the well location.
- No chemicals subject to reporting under the Superfund Amendments and Reauthorization Act Title III in an amount equal to or greater than 10,000 pounds will be used, produced, stored,

transported, or disposed of annually in association with the drilling, testing, or completing of this well.

- No extremely hazardous substances, as defined in 40 CFR 355, in threshold planning quantities, will be used, produced, stored, transported, or disposed of in association with the drilling, testing, or completing of this well.
- The amount of open trench will be minimized ahead of pipe laying and backfilling. No more than ½ mile of trench or the amount of trench that can be worked in a day will be open at any given time. Backfilling operations will be performed within a reasonable amount of time of the lowering operation to ensure the trench is not left open for more than 24 hours. Trenches left open overnight will be fenced with a temporary fence or other methods approved by the Authorized Officer.
- Escape ramps/crossovers will be constructed every 1,320 feet. In areas where active grazing is taking place, escape ramps/crossovers will be placed every 500 feet. The ends of the open trench will be sloped each night with a 3:1 slope.
- Established livestock and wildlife trails will be left in place as crossovers. Escape ramps/crossovers will be constructed with a minimum 3:1 slope at each end of the crossover. Crossovers will be a minimum of 10 feet wide and not fenced.
- The end of the pipe will be plugged to prevent animals from crawling in.
- Before the trench is closed, it will be inspected for animals. Any trapped wildlife or livestock will be promptly removed and released at least 150 yards from the trench.
- All existing improvements (such as fences, gates, and bar ditches) will be repaired to previous or better than pre-construction conditions. Cut fences will be tied to H-braces prior to cutting, and openings will be protected as necessary during construction to prevent the escape of livestock. A temporary closure will be installed on the same day as the fence is cut. Following reclamation, the fence will be reconstructed to BLM specifications.
- Cover from top of pipe to ground level will be a minimum of 36 inches through typical soil and rock and a minimum of 48 inches at drainage of road crossings. Inspection will be conducted to verify that minimum cover is provided, the trench bottom is free of rocks and debris, external pipe coating is not damaged, and the pipe is properly fitted and installed into the ditch.
- Rocks and limbs removed during clearing will be scattered across the workspace in a random arrangement using rubber-tired equipment.
- Open pits will be netted and vent caps placed on all open pipes to prevent bird entry and nesting.
- A migratory bird nest survey will be conducted if any vegetation-disturbing activities occur between May 15 and July 31. The survey must be conducted by a BLM-approved biologist using a survey protocol developed and provided by the BLM/FFO. If active nests are located within the proposed permitted area, project activities will not be permitted without written approval by a BLM/FFO biologist.
- Permanent erosion control measures will be installed after the workspace has been re-contoured. Encana will construct waterbars on all disturbed areas to the spacing and cross sections specified by the Authorized Officer.

- The disturbed areas will be reseeded with a BLM/FFO approved seed mix, either a Sagebrush-Grass Community mix or a Badland mix, as determined during the project onsites. Seeding will be accomplished within 120 days of construction completion, weather permitting. Upon evaluation after the second growing season, seeding will be repeated if a satisfactory stand is not obtained. Cut and fill slopes will be hand seeded with hydro-mulch excelsior netting and/or mulch with netting.
- It will be the operator's responsibility to monitor, control, and eradicate all noxious weed species within the permitted area throughout the life of the proposed project. The operator will contact the BLM/FFO regarding acceptable weed-control methods. If the operator does not hold a current Pesticide Use Permit, a Pesticide Use Permit will be submitted prior to pesticide application. Only pesticides authorized for use on BLM lands will be used. The use of pesticides will comply with federal and state laws. Pesticides will be used only in accordance with their registered use and limitations. The operator will contact the BLM/FFO prior to using these chemicals.
- Production equipment will be placed on location in such a manner to minimize long-term disturbance and maximize interim reclamation. As practical, access will be provided by a teardrop-shaped road through the production area so that the center may be re-vegetated.
- A berm will be constructed completely around any production facilities that contain fluids (i.e., production tanks, produced water tanks, etc.). These berms will be constructed of compacted subsoil, impervious corrugated metal or equivalent and will hold 110 percent of the capacity of the largest tank.
- Production facilities will be painted Covert Green or Juniper Green, as determined during the project onsites to blend with the natural color of the landscape and will be located, to the extent practical, to reasonably minimize visual impact. Equipment subject to safety considerations would not be painted.
- Engines will be equipped with mufflers and barriers or other soundproofing measures would be implemented, if needed, to meet the requirements of BLM Notice to Lessees and Operators on Onshore Oil and Gas Leases within the jurisdiction of the FFO NTL 03-1 FFO.

Site-Specific Design Features for the Lybrook A03-2208

- Corners 2 and 5 will be rounded to reduce the amount of cut and fill.
- Water will be diverted around the pad as needed upon interim reclamation.

Site-Specific Design Features for the Lybrook D12-2208

- Water will be diverted around the pad from corner 3 past corner 4 and from corner 3 around corner 2 into a silt trap.
- A silt trap will be constructed between corner 1 and corner 6.

Site-Specific Design Features for the Lybrook E11-2208

- Corner 3 will be rounded to reduce the amount of cut and fill.
- Water will be diverted around corner 2 to the south.
- Silt traps will be installed upon interim reclamation.
- Indian Service Road 7061 will be bored to construct the well-tie pipeline.
- A cattle guard will be installed on the access road where the BLM allottee fence line is crossed.

Site-Specific Design Features for the Lybrook E12-2208

- Corner 6 will be rounded.
- Water will be diverted and as needed upon interim reclamation.
- A silt trap will be installed between corner 2 and corner 3.

Site-Specific Design Features for the Lybrook E15-2208

- Water will be diverted around the well pad from corner 2 toward corner 3 and from corner 2 to corner 6
- A silt trap will be installed near corner 5.

2.3 Alternative C

As with the proposed action, Alternative C would involve constructing five well pads with associated access roads and pipelines. Four of the well pads (Lybrook A03-2208, Lybrook D12-2208, Lybrook E11-2208, and Lybrook E12-2208) would be the same as described for Alternative B. The proposed Lybrook E15-2208 well pad would in the same location as Alternative B; however, the proposed access road and well-tie pipeline would be different. The proposed well-tie pipeline would be located in the Sections 11, 14, and 15, Township 22 North, Range 8 West, NMPM, in San Juan County, New Mexico. The Lybrook E15-2208 project area would be accessed by utilizing County Road 7950 (the road into Chaco Culture National Historical Park).The proposed access would upgrade existing roads and would be located in the Sections 4, 9, 15, and 16, Township 22 North, Range 8 West, NMPM. The Lybrook E15-2208 alternative would be located on federal, and State of New Mexico lands with the mineral resources administered by the BLM/FFO. A portion of the existing access road that would be upgraded is located on Navajo Nation land. If this alternative was chosen, Encana would have to receive permission from the Navajo Nation and the BIA to upgrade and use the portion of the existing access road.

Drilling of the proposed Lybrook E15-2208 wells would require constructing a 460-foot by 400-foot well pad with a 50-foot-wide construction zone around the perimeter for a total disturbance of approximately 6.43 acres. Maximum cut would be approximately 9.7 feet at corner 2, and the maximum fill would be 9 foot at corner 5. To access the well pad, Encana would construct an approximate 26-foot road and upgrade approximately 13,610-feet of existing road. Encana would also construct and operate a proposed well-tie pipeline approximately 14,971 feet in length. The pipeline would be located on lands managed by the BLM and State of New Mexico. Approximately 3,790-feet of the pipeline will follow the existing road and the remaining pipeline follows an existing pipeline corridor. Table 2-5 lists the project component size per surface owner. The proposed well-tie pipeline would be built within a 40-foot corridor on BLM lands and a 30-foot corridor on State-managed lands, except where it parallels the proposed access road. A 20-foot- wide corridor would be built for the construction of the pipeline following the access road. Additionally, 5,240-feet (2.70 acres) were analyzed in the Lybrook H04-2208 No. 01H EA (EA No. NM-F010-2012-94).

Table 2-5. Project component size/length per land status

Component	Bureau of Land Management (feet)	State of New Mexico (feet)	Total (feet)	Disturbance (acres)

Component	Bureau of Land Management (feet)	State of New Mexico (feet)	Total (feet)	Disturbance (acres)
New Access Road[1]	26	0	26	0.03
Pipeline[2]	11,917	3,054	14,971	10.9 (BLM) 2.1 (State)
Well Pad	500 x 560	0	500 x 560	6.43

[1] parallel to the pipeline 50-foot wide disturbance

[2] 30-foot wide ROW on state land and 40-foot wide on BLM

Total surface disturbance for the proposed project would be 19.5 acres. After interim reclamation, 1.6 acres would remain long-term disturbance.

The total surface disturbance associated with Alternative C would be approximately 69.0 acres. Table 2-6 list the total long- and short-term disturbance for the Lybrook E15-2208 as proposed under Alternative C by land status.

Table 2-6. Short and long-term disturbance by land status for Alternative C

Land Status	Short-term Disturbance (acres)	Long-term disturbance (acres)
Bureau Land Management	17.4	1.6
State of New Mexico	2.1	0
Total	19.5	1.6

As described above under the proposed action, Alternative C would involve construction, drilling and completion, production, pipeline installation, interim reclamation, abandonment, and final reclamation. The general design features described for the proposed action would apply to Alternative C.

Site-Specific Design Features for the Lybrook E15-2208 Alternative C

- Water will be diverted around the well pad from corner 3 toward corner 5.
- Silt traps will be installed upon interim reclamation.
- Existing access will be upgraded back to County Road (CR) 7950.
- A recessed cattle guard and gate will be installed where the upgraded access meets CR 7950.

2.4 Comparison of Alternatives

Table 2-7 provides comparison of total and long-term disturbance between Alternative B and C.

Table 2-7. Comparison of surface disturbance between Alternative B and Alternative C

Component	Alternative B (acres)			Alternative C (acres)		
	Total Disturbance	Long-term Disturbance	New Disturbance	Total Disturbance	Long-term Disturbance	New Disturbance
BLM	66.9	14.5	54.2	67	13.4	52.6
State of New Mexico	0	0	0	2.1	0	1.1
Total	**66.9**	**14.5**	**54.2**	**69.0**	**13.4**	**53.7**

2.5 Alternatives Considered but Eliminated

The applicant analyzed several scenarios to determine how to best develop Sections 3, 11, 12, 15, and 16, Township 22 North, Range 8 West. Using desktop tools and in-field examination, several configurations of the proposed well pads, pipelines, and roads were considered and evaluated by the applicant, the BLM, and natural and cultural resources experts. These alternatives were considered, but have been eliminated from further consideration as they would have resulted in greater environmental impacts or would not have met the proposed action's purpose and need.

An alternative for the Lybrook E12-2208 was identified by the BLM during the onsite process. Twinning this location with the adjacent Lybrook D12-2208 was considered; however, it was eliminated because the location would have excessive cuts and fills. It would also difficult to bring the new access road into the pad due to the wash crossing and topography.

The original access road and pipeline alignment for the Lybrook E12-2208 would have paralleled the proposed Lybrook D12-2208 access road for approximately 1,430 feet before veering off to extend cross country south and east. The road and pipeline alignment were redesigned to parallel the proposed Lybrook D12 road and pipeline for approximately 3,845 feet before extending south to the well pad. Therefore the realignment was designed to reduce the amount of new access for the Lybrook E12 from approximately 3,955 feet to 1,290 feet. The original proposal was eliminated from detailed consideration as it would have resulted in greater surface disturbance. No other alternatives were identified that would create less disturbance and still achieve the purpose and need of the proposed action.

3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This section describes the environment that would be affected by implementation of the alternatives described in Chapter 2. Aspects of the affected environment described in this section focus on the relevant major resources or issues. Under the no action alternative, the proposed action would not be implemented. The no action alternative would result in the continuation of the current land and resource uses in the area. This alternative will not be evaluated further in this EA.

3.1 Methodology

3.1.1 Direct and Indirect Impacts

Ecosphere Environmental Services (Ecosphere) biologists conducted field resource investigations of the proposed action on various dates between June and October 2014. Cultural resource surveys were conducted by La Plata Archaeological Consultants, LLC (LAC) on various dates between October 2012 and March 2014. On-site evaluations were conducted on July 17 and September 9, 2014, and attended by representatives from Encana, Ecosphere, LAC, and the BLM/FFO.

The analysis area for this EA is defined as the project footprint of the proposed well pads, access roads, and pipelines and the alternatives carried forward.

The information about the existing condition of the environment is used as a baseline by which to measure and identify potential impacts from the proposed action and alternative. The analysis considered and incorporated design features, where appropriate, before arriving at the impacts described in the following section. Impacts in this section are analyzed by quantitatively estimating impacts based on the project components of the proposed action and alternatives. When necessary, impacts are analyzed qualitatively. This analysis was developed using the best available science. The primary data sources used for the analysis were the data collected from the site investigations and existing geographic information system (GIS) data and information from the BLM/FFO.

3.1.2 Cumulative Impacts

A Reasonably Foreseeable Development scenario (RFD) was prepared for the FFO in October 2014 (Engler et al. 2014). The RFD identified high, moderate, and low potential regions for oil development of the Mancos-Gallup Formation. Within the high potential region, full development would include five wells per Section, resulting in 1,600 completions. Within the moderate potential region, full development would include one well per Section, resulting in 330 completions. Within the low potential region, full development would include one well per Township, resulting in 30 well completions. Additionally, the RFD predicted 2,000 gas wells could be development in the northeastern corner of the FFO.

The following methods and assumptions were used to predict the potential impact of the development predicted in the RFD.

Past Oil and Gas Development

Past oil and gas wells were identified using the State of New Mexico Oil and Natural Gas Administration and Revenue Database (ONGARD). Following interim reclamation, the average well pad size for past development is 0.75 acre per well pad.

Present and Future Oil Development

Based on previous development, it was assumed that development of the high potential region would involve the twinning of well pads. This is the placement of two or more wells on one well pad. The assumption for the analysis is that the development of a Section would include two twinned well pads and one single well pad, resulting in three well pads for five wells. In the moderate and low potential regions, it was assumed that development would involve single well pads. The proposed action is located in the high potential region.

The average well pad size for a twinned well pad was assumed to be 500 feet by 530 feet, or 6.08 acres. An additional 0.6 acre was added to account for any associated road or pipeline development, resulting in 6.68 acres of short-term disturbance. Following completion of the well, interim reclamation of the well pad and reclamation of any pipelines would occur, resulting in 1.5 acres of long-term disturbance.

The average well pad size for a single well pad was assumed to be 500 feet by 500 feet, or 5.74 acres. Again, an additional 0.6 acre was added to account for associated road or pipeline development, resulting in 6.34 acres of long-term disturbance. Following completion of the well, interim reclamation of the well pad and reclamation of any pipelines would occur, resulting in 1.5 acres of long-term disturbance.

The Random Point Tool in ArcMap was used to randomly assign points representing well pads and associated disturbance based on the RFD assumptions: five wells per section in the high potential region, one well per section in the moderate potential region, and one well per township in the low potential region. The allowed both long-term and short-term disturbance from oil development of the Mancos-Gallup Formation to be calculated for the analysis areas used in this EA.

Present and Future Gas Development

The RFD predicted 2,000 wells could be developed in the gas prone area. The average well pad size was assumed to be 555 feet by 410 feet, or 5.22 acres. An additional 0.6 acre of disturbance was added to account for associated roads and pipelines, resulting in total disturbance of 5.82 acres. Following completion of the well, interim reclamation of the well pad and reclamation of any pipelines would occur, resulting in 1.5 acres of long-term disturbance.

The Random Point Tool in ArcMap was used to randomly assign points representing one well pad and associated disturbance. The allowed both long-term and short-term disturbance from gas development in the northeastern corner of the FFO to be calculated for the analysis areas used in this EA No gas wells were predicted for any of the analysis areas used in the EA.

3.2 Air Resources

3.2.1 Affected Environment

The proposed action would be located in San Juan County, New Mexico. Additional general information on air quality in the area is contained in Chapter 3 of the Farmington PRMP/FEIS. In addition, new information about greenhouse gases (GHGs), including their effects on national and global climate conditions, has emerged since this document was prepared. On-going scientific research has identified the potential impacts of GHG emissions such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (NO_X), water vapor, and several trace gases on global climate. Through complex interactions on a global scale, GHG emissions may cause a net warming effect of the atmosphere, primarily by decreasing the amount of heat energy radiated by the earth back into space. Although GHG levels have varied for millennia (along with corresponding variations in climatic conditions), industrialization and burning of fossil carbon sources have caused GHG concentrations to increase measurably, and may contribute to overall climatic changes, typically referred to as global warming.

Much of the information referenced in this section is incorporated from the Air Resources Technical Report for BLM Oil and Gas Development in New Mexico, Kansas, Oklahoma, and Texas (herein referred to as Air Resources Technical Report (USDI/BLM 2014). This document summarizes the technical information related to air resources and climate change associated with oil and gas development, and the methodology and assumptions used for analysis.

The U.S. Environmental Protection Agency (USEPA) has the primary responsibility for regulating air quality, including six nationally regulated ambient air pollutants (criteria pollutants). These criteria pollutants include carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM_{10} and $PM_{2.5}$), sulfur dioxide (SO_2) and lead (Pb). USEPA has established National Ambient Air Quality Standards (NAAQS) for criteria air pollutants. The NAAQS are protective of human health and the environment. USEPA has approved New Mexico's State Implementation Plan, and the state enforces state and federal air quality regulations on all public and private lands within the state, except for tribal lands and within Bernalillo County. Air quality is determined by atmospheric pollutants and chemistry, dispersion meteorology and terrain, and also includes applications of noise, smoke management, and visibility. Climate is the composite of generally prevailing weather conditions of a particular region throughout the year, averaged over a series of years. The USEPA has proposed or completed actions recently to implement Clean Air Act requirements for greenhouse gas emissions. Climate has the potential to influence renewable and non-renewable resource management.

Air Quality

The Air Resources Technical Report describes the types of data used for description of the existing conditions of criteria pollutants, how the criteria pollutants are related to the activities involved in oil and gas development, and provides a table of current National and state standards. USEPA's Green Book web page (USEPA 2013a) reports that all counties in the Farmington Field Office area are in attainment of all NAAQS as defined by the Clean Air Act. The area is also in attainment of all state air quality standards (NMAAQS). The current status of criteria pollutant levels in the Farmington Field Office are described below.

"Design Values" are the concentrations of air pollution at a specific monitoring site that can be compared to the NAAQS. The 2012 design values for criteria pollutants are listed below in Table 1. There is no monitoring for CO and Pb in San Juan County, but because the county is relatively rural, it is likely that these pollutants are not elevated. PM_{10} design concentrations are not available for San Juan County.

Table 3-1. 2012 criteria pollutant monitored design concentrations in San Juan County

Pollutant	2012 Design Concentrations	Averaging Time	NAAQS	NMAAQS
O_3	0.071 ppm	8-hour	0.075 ppm(1)	
NO_2	13 ppb	Annual	53 ppb(2)	50 ppb
NO_2	38 ppb	1-hour	100 ppb(3)	
$PM_{2.5}$	4.7 $\mu g/m^3$	Annual	12 $\mu g/m^3$ (4)	60 $\mu g/m^3$ (6)
$PM_{2.5}$	14 $\mu g/m^3$	24 hour	35 $\mu g/m^3$ (3)	150 $\mu g/m^3$ (6)
SO_2	19 ppb	1-hour	75 ppb(5)	

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

(2) Not to be exceeded during the year.

(3) 98th percentile, averaged over 3 years.

(4) Annual mean, averaged over 3 years.

(5) 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years.

(6) The NMAAQS is for Total Suspended Particulate.

Note: NAAQS = National Ambient Air Quality Standard Standards; NMAAQS = New Mexico Ambient Air Quality Standards; O_3 = ozone; NO_2 = nitrogen dioxide; $PM_{2.5}$ = particulate matter with a diameter of 2.5 micrometers or less; ppb = parts per billion; ppm = parts per million; SO_2 – sulfur dioxide; $\mu g/m^3$ = micrograms per cubic meter.

Source: USEPA 2014

In 2005, the USEPA estimated that there was less than 0.01 ton per square mile of Pb emitted in FFO counties, which is less than 2 tons total (USEPA 2012). Lead emissions are not an issue in this area and will not be discussed further.

Air quality in a given region can be measured by its Air Quality Index (AQI) value. The AQI is reported according to a 500-point scale for each of the major criteria air pollutants, with the worst denominator determining the ranking. For example, if an area has a CO value of 132 on a given day and all other pollutants are below 50, the AQI for that day would be 132. The AQI scale breaks down into six categories: good (AQI<50), moderate (50-100), unhealthy for sensitive groups (101-150), unhealthy (151 to 200), very unhealthy (201 to 300) and hazardous (301 to 500). The AQI is a national index; the air quality rating and the associated level of health concern is the same everywhere in the country. The AQI is an important indicator for populations sensitive to air quality changes.

Mean AQI values for San Juan County were generally in the good range (AQI<50) in 2013 with 80 percent of the days in that range. The median AQI in 2013 was 42, which indicates "good" air quality. The maximum AQI in 2013 was 156, which is "unhealthy."

Although the AQI in the region has reached the level considered unhealthy for sensitive groups on several days almost every year in the last decade, there are no patterns or trends to the occurrences (Table 3-2). During the past decade, the air quality reached an "unhealthy" level on 8 days in the past decade, and on 2

days, the air quality reached the level of "very unhealthy." In 2009 and 2012, there were no days that were "unhealthy for sensitive groups" or worse in air quality. In 2005 and 2013, there was 1 day that was "unhealthy" during each year. In 2010, there were 5 "unhealthy" days and 2 "very unhealthy days."

Table 3-2. Number of days classified as "unhealthy for sensitive groups" (AQI 101-150) or worse

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Days	3	6	9	18	1	0	12	9	0	1

Source: USEPA 2013b

Hazardous Air Pollutants

The Air Resources Technical Report discusses the relevance of hazardous air pollutants (HAPs) to oil and gas development and the particular HAPs that are regulated in relation to these activities (USDI/BLM 2014). The USEPA conducts a periodic National Air Toxics Assessment (NATA) that quantifies HAP emissions by county in the U.S. The purpose of the NATA is to identify areas where HAP emissions result in high health risks and further emissions reduction strategies are necessary. A review of the results of the 2005 NATA shows that cancer, neurological, and respiratory risks in San Juan County are generally lower than statewide and national levels as well as those for Bernalillo County, where urban sources are concentrated in the Albuquerque area (USEPA 2012).

Climate

The analysis area is located in a semi-arid climate region, typified by dry windy conditions and limited rainfall. Summer maximum temperatures are generally in the range of 80 or 90 degrees Fahrenheit (°F), and winter minimum temperatures are generally in the teens to 20s. Temperatures occasionally reach above 100°F in June and July, and have dipped below 0°F in December and January. Precipitation is divided between summer thunderstorms associated with the southwest monsoon and winter snowfall as Pacific weather systems drop south into New Mexico.

Table 3-3 shows climate normals for the 30-year period from 1981 to 2010 for the Farmington, New Mexico, area.

Table 3-3. Climate normals for the Farmington area, 1981-2010

Month	Average Temperature[1]	Average Maximum Temperature[1]	Average Minimum Temperature[1]	Average Precipitation (inches)
January	30.5	40.8	20.3	0.53
February	35.8	46.8	24.8	0.59
March	43.2	56.1	30.3	0.78
April	50.4	64.7	36.2	0.65
May	60.4	74.8	46.1	0.54
June	69.8	85.1	54.5	0.21
July	75.4	89.6	61.2	0.90
August	73.2	86.5	59.8	1.26
September	65.4	79.1	51.7	1.04
October	53.3	66.4	40.1	0.91

Month	Average Temperature[1]	Average Maximum Temperature[1]	Average Minimum Temperature[1]	Average Precipitation (inches)
November	40.5	52.2	28.8	0.68
December	31.0	41.2	20.7	0.50

Source: USDI/BLM 2014

[1] Degrees Fahrenheit

Very recently, pioneering research using space-borne (satellite and aircraft) determination of methane concentrations have indicated anomalously large methane concentrations may occur in the Four Corners region (Kort et al. 2014). A subsequent study (Schneising et al. 2014) indicated larger anomalies over other oil and gas basins in the U.S. Methane is 34 times more potent at trapping greenhouse gas emissions than CO_2 when considering a time horizon of 100 years (Intergovernmental Panel on Climate Change 2013). While space-borne studies can determine the pollutant concentration in a column of air, these studies cannot pinpoint the specific sources of air pollution. Further study is required to determine the sources responsible for methane concentrations in the Four Corners region; however, it is known that a significant amount of methane is emitted during oil and gas well completion (Howarth et al. 2011). Methane is also emitted from process equipment, such as pneumatic controllers, and liquids unloading at oil and gas production sites. Ground-based, direct source monitoring of pneumatic controllers conducted by the Center for Energy and Environmental Resources (Allen et al. 2014b) show that methane emissions from controllers exhibit a wide range of emissions, and a small subset of pneumatic controllers emitted more methane than most. Emissions measured in the study varied significantly by region of the U.S., the application of the controller and whether the controller was continuously or intermittently venting. The Center for Energy and Environmental Resources had similar findings of variability of methane emissions from liquid unloading (Allen et al. 2014a). In October 2012, USEPA promulgated air quality regulations controlling volatile organic compounds (VOC) emissions at gas wells. These rules require air pollution mitigation measures that reduce the emissions of VOCs. These same mitigation measures have a co-benefit of reducing methane emissions. Future ground-based and space-borne studies planned in the Four Corners region with emerging pollutant measurement technology may help to pinpoint significant, specific sources of methane emissions in the region.

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

3.2.2 Impacts from Alternative B: Proposed Action

Methodology and assumptions for calculating air pollutant and greenhouse gas emissions are described in the Air Resources Technical Report (USDI/BLM 2014). This document incorporates the sections discussing the modification of calculators developed by the BLM to address emissions for one horizontal oil well. The calculators give an approximation of criteria pollutant, HAP, and GHG emissions to be compared to regional and national emissions levels. Also incorporated into this document are the sections describing the assumptions used in developing the inputs for the calculator (USDI/BLM 2014).

Direct and Indirect Impacts

Table 3-4 shows estimated emissions from one proposed horizontal oil well for criteria pollutants, VOCs and GHGs. For comparison, Table 3-5 shows total human-caused emissions for each of the counties in the FFO and La Plata County, Colorado, based on USEPA's 2011 emissions inventory (USEPA 2014).

Table 3-4. Criteria pollutant and VOC emissions estimated for construction of one horizontal oil well; average 25 days to drill and complete

Activity	NOx(1)	CO(2)	VOC(3)	PM_{10}(4)	$PM_{2.5}$(5)	SO_2(6)	CH_4(7)	CO_2(8)
One-time operations (tons)								
Construction	5.5	1.5	0.5	2.5	0.25	0.1	0.007	598.85
Completion	0.5	0.1	0.03	0.025	0.025	-	-	55.00
Interim Reclamation	0.006	0.006	0.006	0.001	-	0.003	-	1.24
Final Reclamation	0.006	0.006	0.006	0.001	-	0.004	-	1.66
Ancillary Operations (tons)								
Workover	0.129	0.04	0.01	0.01	0.01	-	-	10.59
Road Maintenance	-	-	-	-	-	-	-	0.26
Road Traffic	-	-	-	-	-	-	-	0.06
Annual operations (tons/yr)								
Equipment Leaks	-	-	-	-	-	-	0.013	-
Field Compression	0.14	0.29	0.10	0.01	0.01	-	-	19.30
Total	**6.28**	**1.94**	**0.65**	**2.55**	**0.30**	**0.11**	**0.02**	**686.96**

Notes: NO_X = nitrogen oxides; CO = carbon monoxide; VOC = volatile organic compounds; PM10 = particulate matter with an aerodynamic diameter equal to or less than 10 microns; PM2.5 = particulate matter with an aerodynamic diameter equal to or less than 2.5 microns; SO2 = sulfur dioxide; CH4 = methane; CO2 = carbon dioxide; bbl = barrel; yr = year.

Table 3-5. Analysis area emissions in tons/year, 2011

County	NO_X	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2
McKinley	11,952.9	17,007.8	3,891.2	70,096.4	7,645.2	1,381.1
Rio Arriba	12,012.3	27,344.6	19,149.8	33,761.2	4,130.6	60.4
San Juan	42,231.5	63,568.9	26,110.8	76,638.3	9,201.0	5,559.3
Sandoval	4,143.8	19,513.9	4,373.1	39,343.0	4,510.8	109.3
La Plata	4,838.2	17,116.3	3,740.1	2,330.0	919.6	127.9
Total	**75,187.7**	**144,551.5**	**57,265.1**	**222,168.9**	**26,407.2**	**7,237.9**

Notes: NO_X = nitrogen oxides; CO = carbon monoxide; VOC = volatile organic compounds; PM_{10} = particulate matter with an aerodynamic diameter equal to or less than 10 microns; $PM_{2.5}$ = particulate matter with an aerodynamic diameter equal to or less than 2.5 microns; SO_2 = sulfur dioxide.

Table 3-6 displays the percent increase in total emissions in the analysis area from the proposed action to construct and operate one horizontal oil well.

Table 3-6. Percent increase in analysis area emissions

	NO_X	CO	VOC	PM_{10} [2]	$PM_{2.5}$ [1]	SO_2 [2]
Total Emissions	75,187.7	144,551.5	57,265.1	222,168.9	26,407.2	7,237.9
Horizontal Gas Well Emissions	6.28	1.94	0.65	2.55	0.30	0.13
Percent Increase	**0.008**	**0.001**	**0.001**	**0.001**	**0.001**	**0.002**

Notes: NO_X = nitrogen oxides; CO = carbon monoxide; VOC = volatile organic compounds; PM_{10} = particulate matter with an aerodynamic diameter equal to or less than 10 microns; $PM_{2.5}$ = particulate matter with an aerodynamic diameter equal to or less than 2.5 microns; SO_2 = sulfur dioxide.

[1] Current USEPA regulations require operators to reduce VOC emissions by 95 percent if their oil storage tanks emit over six tons of VOC emissions per year.

[2] Values derived from average emissions for any well drilling in the analysis area; calculated results available upon request.

Hazardous Air Pollutants

The formulas used for calculating HAPs in the calculators are very imprecise. For many processes, it is assumed that emission of HAPs will be equivalent to 10 percent of VOC emissions. Therefore, the estimated HAP emissions of 0.09 tons/year should be considered a very gross estimate.

Total Greenhouse Gases

The available statewide GHG summary combines GHG emissions from CO_2 and CH_4. To compare the GHG emissions from the Proposed Action estimated by the calculator with statewide GHG emissions, carbon dioxide equivalent (CO_2e) emissions for both CH_4 and CO_2 were summed. The total statewide GHG emission estimate for 2007 was 76,200,000 metric tons CO_2e (76.2 million metric tons) (NMED 2010). The estimated CO_2e metric tons emissions from one horizontal gas well (623.2 metric tons) would represent a 0.0008 percent increase in New Mexico CO_2 emissions.

Cumulative Impacts

The FFO manages federal hydrocarbon resources in San Juan, Sandoval, Rio Arriba, and McKinley Counties. 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. Analysis of cumulative impacts for reasonable development scenarios of oil and gas wells on public lands in the FFO was presented in the 2003 RMP. This included modeling of impacts on air quality. A more detailed discussion of Cumulative Effects can be found in the Air Resources Technical Report (USDI/BLM 2014).

The primary activities that contribute to levels of air pollutant and GHG emissions in the Four Corners area are electricity generation stations, fossil fuel industries, and vehicle travel. The Air Quality Technical Report includes a description of the varied sources of national and regional emissions that are incorporated here to represent the past, present, and reasonably foreseeable impacts to air resources (USDI/BLM 2014). It includes a summary of emissions on the national and regional scale by industry source. Sources that are considered to have notable contributions to air quality impacts and GHG emissions include electrical generating units, fossil fuel production (nationally and regionally), and transportation.

The emissions calculator estimated that there could be very small direct and indirect increases in several criteria pollutants, HAPs, and GHGs as a result of implementing the proposed alternative. The very small

increase in emissions that could result would not be expected to result in exceeding the NAAQS for any criteria pollutants in the analysis area.

The very small increase in GHG emissions that could result from implementing the proposed alternative would not produce climate change impacts that differ from the no action alternative. This is because climate change is a global process that is impacted by the sum total of GHGs in the Earth's atmosphere. The incremental contribution to global GHGs from the action alternatives cannot be translated into effects on climate change globally or in the area of this site-specific action. It is currently not feasible to predict with certainty the net impacts from the action alternatives on global or regional climate.

The Air Resources Technical Report (USDI/BLM 2014) discusses the relationship of past, present, and future predicted emissions to climate change and the limitations in predicting local and regional impacts related to emissions. It is currently not feasible to know with certainty the net impacts from particular emissions associated with activities on public lands.

3.2.3 Impacts from Alternative C

Direct and Indirect Impacts

Impacts from Alternative C on air quality would be the same as those described under Alternative B.

Cumulative Impacts

Cumulative impacts would be the same as those described under Alternative B.

3.3 Soils

Surficial geology in the analysis area is composed of the Nacimiento Formation and soils are classified as Badland; Blancot-Notal association, gently sloping; Doak-Sheppard-Shiprock association, rolling; and Fruitland-Persayo-Sheppard complex, hilly mapping unit (USDA/SCS 1980).

The Nacimiento Formation consists of non-marine fluvial depositions created during the Paleocene in the San Juan Basin (New Mexico Bureau of Geology and Mineral Resources 2003). The formation is comprised mostly of shale, interbedded with medium to fine grained sandstone and conglomeratic sandstone (McLemore et al. 1986). The Nacimiento Formation is well-known for containing a significant early Paleocene vertebrate fossil record (Williamson and Lucas 1992).

The Badland mapping unit occurs on a portion of the Lybrook E15-2208 access road and pipeline alignment under Alternative C. There are no Badland soils within the Alternative B project components. The Badland mapping unit is classified as somewhat excessively drained and highly erodible. Badlands are steep or very steep, commonly non-stony, barren land dissected by many intermittent drainage channels. Runoff potential is very high, and geologic erosion is active (USDA/SCS 1980).

The Blancot-Notal association, 0 to 5 percent slopes, is found on fans, and in valleys and is composed of approximately 50 percent Blancot loam and 25 percent Notal silty clay loam. This mapping unit is deep and well to excessively drained. Effective rooting depth is 60 inches or greater. The major limitations of this mapping unit are runoff, water erosion, and blowing soil (USDA/SCS 1980).

The Doak-Sheppard-Shiprock association occurs in two small areas of the Lybrook E15-2208 access road and pipeline under Alternative C and the proposed Lybrook E11-2208 pipeline alignment under both action alternatives. The Doak-Sheppard-Shiprock association, rolling, is found on mesas, plateaus, and terraces and is composed of approximately 40 percent Doak loam, 30 percent Sheppard loamy fine sand, and 20 percent Shiprock fine sandy loam. This mapping unit is deep and well to excessively drained. Effective rooting depth is 60 inches or greater. The major limitations of this mapping unit are blowing soil and water erosion (USDA/SCS 1980).

The Fruitland-Persayo-Sheppard complex, hilly, 5 to 30 percent slopes, is found on hills, mesas, plateaus, fans, and breaks and is composed of approximately 40 percent Fruitland sandy loams, 30 percent Persayo clay loam, and 25 percent Sheppard loamy fine sand. This mapping unit comprises the majority of soils found in the analysis area. The mapping unit is well to excessively drained and shallow to deep. The major limitations of this mapping unit are blowing soil and water erosion (USDA/SCS 1980).

3.3.1 Impacts from Alternative B: Proposed Action

Direct and Indirect Impacts

The proposed action would affect approximately 66.9 acres of soils from four mapping units. There are no Badland soils within the proposed action footprint. Construction would result in temporary displacement, compaction, and mixing of soils. The well pads and new access roads (approximately 14.5 acres) would remain as bare, compacted soil for the life of the project (approximately 30 years) and would be subject to an undetermined amount of wind and water erosion until the wells and roads are completely reclaimed. Compaction of the soils during construction and operation of the proposed action, coupled with implementation of design features described below, would limit soil impacts from erosion. Soils are most susceptible to erosion during construction, when strong winds or precipitation events during soil-disturbing activities could mobilize soils. The impact on soils would be localized and short to long term.

Industry-related vehicle and pedestrian traffic would be restricted to proposed disturbance areas and existing roads. Following construction activities, unused areas would be reseeded with the BLM-approved seed mixes to stabilize soils and prevent erosion. Following construction, vehicle traffic would be restricted to existing bladed roads to prevent erosion, soil mixing, and compaction in adjacent areas. Proper soil salvage, storage, and reclamation will allow adequate infiltration and permeability rates and maintain soil moisture, which is necessary for plant growth and vigor, and minimize surface runoff. The operator will be required to meet all the FFO Bare Soil Reclamation Procedure (2/1/2013) requirements and standards. The operator must submit a plan that addresses the construction, reclamation, reseeding and monitoring of the proposed projects. Proper reclamation and monitoring will reduce the opportunity for soil erosion.

Cumulative Impacts

The cumulative impact analysis area for the proposed action is the Escavada Wash watershed (hydrologic unit code 10). Past, present, and future developments are expected to result in a range of short- and long-term impacts to soils, including disturbance, temporary or permanent increases in erosion prior to reclamation, and reduction of soil loss to erosion where reclamation and re-vegetation occurs. One hundred and five oil and gas wells have been developed in the Escavada Wash watershed. These wells have resulted in approximately 371 acres of surface disturbance. Based on the RFD (Engler et al. 2014),

oil and gas development in the watershed may result in approximately 2,116 acres of short-term disturbance and 489 acres of long-term disturbance. The proposed action would result in approximately 66.9 acres of short-term surface disturbance and 14.5 acres of long-term disturbance in the Escavada Wash watershed, or approximately 3 percent of the RFD estimated disturbance in the Escavada Wash watershed. Impacts from the proposed action are not expected to contribute appreciably to cumulative impacts to soils when added to past, present, and reasonably foreseeable actions.

3.3.2 Impacts from Alternative C

Direct and Indirect Impacts

Alternative C would impact approximately 69.0 acres of soil, including 13.4 acres that would be affected in the long term. Impacts would be similar to those described under Alternative B and would be minimized by the implementation of design features.

Cumulative Impacts

Cumulative impacts to soils would be indistinguishable from those described for Alternative B.

3.4 Upland Vegetation and Noxious Weeds

3.4.1 Affected Environment

The analysis area is located within the Arizona/New Mexico Plateau eco-region and is further classified as San Juan/Chaco Tablelands and Mesas (Griffith et al. 2006). Two vegetation community types occur within the analysis area—Great Basin desert scrub sagebrush series and open canopy Piñon-Juniper Woodland (Dick-Peddie 1993). Approximately 51 to 54 acres of existing disturbance associated with roads and pipeline corridors occurs within the analysis area.

Dominant species observed in desert scrub community type include blue grama (*Bouteloua gracilis*), big sagebrush (*Artemisia tridentata*), wolfberry (*Lycium* sp.), fourwing saltbush (*Atriplex canescens*), alkali sacaton (*Sporobolus airoides)* and James' galleta (*Pleuraphis jamesii*). The proposed Lybrook A03-2208, Lybrook D12-2208, Lybrook E11-2208, Lybrook E15-2208, and Lybrook E15-2208 (alternative) well pads, well-tie pipelines and access roads, and the proposed Lybrook E12-2208 well pad are located within this community type. Big sagebrush in the proposed Lybrook A03-2208, Lybrook D12-2208, Lybrook E12-2208, and the Lybrook E15-2208 project areas was desiccated.

Wooded areas in the analysis area are dominated by open canopy piñon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) with understory species such as and antelope bitterbrush (*Purshia tridentata*). Trees are widely scattered with low canopy cover and minimal understory. The proposed Lybrook E12-2208 and Lybrook D12-2208 access road and pipeline cross through scattered patches of open canopy piñon-juniper woodland.

Under Alternative C, the Lybrook E15-2208 alternative access road and pipeline ROWs also cross through patches of trees on ridges and slopes.

Table 3-7 lists the project components with the estimated percent vegetation cover, number of trees, and noxious weeds observed during the biological surveys in the analysis area.

Table 3-7. Percent vegetation cover, number of trees, and noxious weeds present in the analysis area

Component	Vegetation Cover (%)	Number of Trees	Noxious Weeds
Lybrook A03-2208	40-50	33	Russian knapweed (*Acroptilon repens*)
Lybrook D12-2208	20-60	17	Musk thistle (*Carduus nutans*)
Lybrook E11-2208	30-40	30	Halogeton (*Halogeton glomeratus*)
Lybrook E12-2208	20-50	51	Halogeton (*Halogeton glomeratus*)
Lybrook E15-2208	40-70	11	Halogeton (*Halogeton glomeratus*)
Lybrook E15-2208 (Alternative C)	40-60	56	Halogeton (*Halogeton glomeratus*)

One BLM Class B noxious weed species, halogeton (*Halogeton glomeratus*), was observed within the proposed Lybrook E11-2208 well pad, the pipeline and access for the Lybrook D12-2208 and the Lybrook E12-2208, and the proposed Lybrook E15-2208 pipeline alignment during the biological surveys. Russian knapweed (*Acroptilon repens*), also a Class B weed species, was observed on the proposed Lybrook A03-2208 pipeline and access road during the field surveys; however, it could not be found during the onsite on July 17, 2014, possibly due to dry conditions.

Halogeton was also recorded within the Lybrook E15-2208 Alternative C pipeline alignment during the biological surveys.

3.4.2 Impacts from Alternative B: Proposed Action

Direct and Indirect Impacts

Direct impacts would include removal of vegetation during site-clearing activities. Construction of the proposed action would result in the removal and modification of approximately 54.2 acres of undisturbed vegetation. The proposed action would result in the removal of approximately 142 piñon pine and Utah juniper trees. Potential impacts include changes in species composition and density and an increased potential for invasive species to establish. Following reclamation, there would be long-term changes in the density and composition of analysis area vegetation communities. Trees may not re-establish in the area for several decades. Disturbed areas would be expected to re-vegetate in 2 or more years. There would be a long-term loss of approximately 14.5 acres of desert scrub and open canopy piñon-juniper woodland vegetation for well access and operation.

Invasive species are generally tolerant of disturbed conditions, and disturbed soils at project sites may provide an opportunity for the introduction and establishment of non-native invasive species. During construction and operation, noxious weed sources could be introduced to disturbed areas from vehicles, equipment, people, wind, water, or other mechanisms. There would be a long-term potential for noxious weeds to establish or spread in the area. Encana would be responsible for monitoring and controlling any noxious weed species within the ROWs and well pads for the life of the project.

Re-vegetation of well pad construction zones and the pipeline ROWs would be initiated by Encana within 120 days of well completion and pipeline construction. All vegetation removed during site-clearing activities would be mowed and incorporated into stockpiled topsoil. Trees that are 3 inches or greater in diameter would be cut and de-limbed. The proposed Lybrook A03-2208, Lybrook D12-2208, Lybrook E12-2208, Lybrook E15-2208 would be reseeded with the Sagebrush-Grass Community seed mix, while the Lybrook E11-2208 would be reseeded with the Badland Community seed mix.

Cumulative Impacts

The cumulative impact analysis area for vegetation and noxious weeds is the Escavada Wash watershed. One hundred and five oil and gas wells have been developed in the Escavada Wash watershed. These wells have resulted in approximately 371 acres of surface disturbance. Based on the RFD (Engler et al. 2014), oil and gas development in the watershed may result in approximately 2,116 acres of short-term disturbance and 489 acres of long-term disturbance. Other activities that may impact vegetation in the analysis area include livestock grazing, vegetation management, wildfire, and major ROW projects. The proposed action would result in approximately 54.2 acres of short-term surface disturbance to undisturbed vegetation and 14.5 acres of long-term disturbance in the Escavada Wash watershed. The proposed action would contribute approximately 3 percent of the RFD estimated disturbance in the Escavada Wash watershed. When added to past, present, and future actions, the proposed action is not expected to result in significant cumulative impacts.

3.4.3 Impacts from Alternative C

Direct and Indirect Impacts

Under Alternative C, the types of impacts to vegetation would be the same as those described under Alternative B. Alternative C would impact approximately 53.7 acres of undisturbed vegetation in the short term and 13.4 acres in the long term. An estimated 184 piñon and juniper trees would be removed under Alternative C. The Lybrook E15-2208 alternative project area would be reseeded with the Sagebrush-Grass Community seed mix.

Implementing Alternative C would have the same effect on noxious weeds as Alternative B. There would be a long-term potential for non-native invasive weeds to establish or spread in the area. Encana would be responsible for monitoring and controlling any non-native invasive weed species within the well pads and ROWs for the life of the projects.

Cumulative Impacts

Cumulative impacts would be similar to those of Alternative B. However, Alternative C would affect approximately 13.4 acres of vegetation in the long term.

3.5 Wildlife

3.5.1 Affected Environment

The proposed action is not located within a BLM wildlife specially designated area (SDA). There are no unique habitats within the analysis area. The analysis area is dominated by a Great Basin desert scrub

vegetation community with areas of open canopy piñon-juniper woodland on ridges and slopes. Wildlife common to this habitat include elk (*Cervus elaphus*), mule deer (*Odocoileus hemionus*), fox (*Vulpes* sp.), black-tailed jackrabbit (*Lepus californicus*), desert cottontail (*Sylvilagus audubonii*), and reptiles (snakes and lizards). Black bear (*Ursus americanus*), coyote (*Canis latrans*), fox (*Vulpes sp*.) mule deer, black-tailed jackrabbit, desert cottontail, kangaroo rat (*Dipodomys* spp.), prairie dog (*Cynomys sp.),* pronghorn (*Antilocapra americana*) and woodrat (*Neotoma* sp.) sign (burrows, tracks, scat) were observed during the biological surveys.

3.5.2 Impacts from Alternative B: Proposed Action

Direct and Indirect Impacts

Two parameters are considered when evaluating habitat loss—direct habitat loss and effective habitat loss. Direct habitat loss occurs through the removal of vegetation, which reduces the extent or quality of habitat in terms of food and cover. Vegetation removal strips the affected area of its value to wildlife; therefore, direct habitat loss can be quantified by comparing the area of habitat lost to the amount retained. The amount of habitat available to wildlife is called effective habitat. The effectiveness of habitat is lost when a species reduces use or avoids an area. Loss of effective habitat area can exceed direct habitat loss. Effective habitat loss can occur from habitat fragmentation, disturbance, and interference with movement. The impacts of habitat fragmentation are related to the loss of large contiguous areas of habitat and the relative increase in habitat “edge” in smaller areas. Construction of roads and other development, as well as human and vehicular traffic on existing roads, can cause habitat fragmentation. Such disturbance can cause animals to shift their activity or alter their behavior.

The proposed action would result in the removal and modification of approximately 54.2 acres of undisturbed vegetation including removal of an estimated 142 piñon and juniper trees of varying ages and sizes that are mainly located along the proposed Lybrook E12-2208 access road and well-tie pipeline alignments. Vegetation communities within the proposed analysis area provide forage for big game and other wildlife species. Since the vegetation removed would not be replaced with the same species and because the removal of vegetation in previously undisturbed areas would result in habitat fragmentation, an alteration of available wildlife habitat and utilization is anticipated. Impacts to wildlife habitat would include short-term loss of natural vegetation and changes in composition of vegetation. The majority of direct habitat loss would be short term, as areas reclaimed would recover their value as wildlife habitat. However, there would be a long-term loss of approximately 14.5 acres for well operation and access. Most species observed or expected to inhabit the area are generalists and would be minimally affected by the changes in vegetation composition.

Mule deer and elk have been shown to avoid natural gas wells, roads, and areas immediately surrounding them, resulting in a loss of effective habitat. Hebblewhite (2011) summarized that the average zone of influence reported in eight different studies extended about 1,000 meters (3,281 feet) from roads and wells. The nature and extent of this avoidance is dependent upon the type of vegetation—particularly the amount of cover present, topography, the volume of traffic, and whether or not vehicles stop or continue moving; however, responses varied within seasons and among species. Disturbance is a primary factor in effective habitat loss, as it can alter the ways wildlife use or move through an area and could push individual animals from preferred habitat into less suitable habitat. Such displacement would likely be

localized around the source of the disturbance (i.e., equipment noise, human presence, etc.). Data collected by the BLM and New Mexico Department of Game and Fish in the Rosa Wildlife SDA between 1994 and 2012 indicate a positive correlation between the increasing number of gas wells and accompanying roads and the decline in mule deer fawn to doe ratios.

Since there is so much variability between studies, and no studies specific to the BLM/FFO have been completed, a conservative buffer of 400 meters (1,312 feet) was selected to quantify the potential effective habitat loss resulting from the proposed action. Based on a 400-meter buffer of the proposed action, indirect wildlife habitat loss would affect approximately 1,388 acres.

Avoidance by wildlife would depend on the species, time of day, time of year, human activity level, topography, and cover type. It should also be noted that the zone of influence around roads and well pads does not imply 100 percent avoidance (Hebblewhite 2011). Impacts from effective habitat loss would be greatest during construction and drilling and would decrease over time in correlation to human and vehicular activity levels.

During construction, drilling, and completion, there would be short-term impacts to area wildlife because of human and vehicular activity and associated noise. Wildlife in the area would be displaced to adjacent habitat or may temporarily avoid the area during construction activities. Once the project is complete, wildlife would likely return to the area. It is possible that small wildlife, particularly burrowing species, may be killed during construction. During operation, the level of human and vehicular activity in the analysis area would decrease substantially. However, one light-duty vehicle would continue to access the area on near daily basis. Heavy-duty vehicles (semi-trucks) would access the well sites 1 to 2 times a day for approximately 6 months, after which traffic trips would decrease to approximately 1 trip per month. Long-term impacts from vehicle traffic on roads could include incidental mortality to wildlife. Animal-vehicle collisions are variable depending on the time of day, speed and volume of traffic, local topography, structural features of the road, and the size and behavior of the individual species. The proposed access roads would also facilitate entry to areas not previously open to vehicular travel, potentially resulting in increases in legal and illegal hunting.

Wildlife could come into contact with chemicals or fluids stored on-site. Use of a closed-loop system would minimize potential impacts to wildlife from exposure to chemicals or fluids during drilling and completion. During operation, any open pits would be netted and vent caps placed on all open pipes to prevent bird entry and nesting. Any spills would be promptly cleaned up, and Encana maintains an emergency response plan. All chemicals or fluids stored on-site would be properly contained and would have secondary containment.

Construction activities would be confined to the permitted area to avoid further disruption to wildlife. Re-vegetation would be initiated immediately following construction or at the direction of the BLM/FFO. Gaps would be made, as needed, in topsoil or subsoil stockpiles to allow for wildlife crossings and to avoid ponding or excessive diversion of natural runoff during storm events. Trenches would be inspected for wildlife prior to laying pipe and back filling; trenches would not be left open more than 24 hours. Adherence to BLM reclamation and sanitation measures would also minimize potential impacts to wildlife.

Cumulative Impacts

The cumulative impacts analysis area for assessing impacts to wildlife is the Escavada Wash watershed. Reasonably foreseeable development within the Escavada Wash watershed may include an estimated additional 326 oil and gas wells and related facilities and 39 miles of new roads based on the assumption that 196 new well pads could be developed in the watershed. Surface-disturbing activities associated with these actions may directly affect an estimated 2,116 acres of wildlife habitat. Other reasonably foreseeable actions such as continued livestock grazing, vegetation treatments, and community development would cumulatively impact wildlife through direct and effective habitat loss. The proposed action would cumulatively contribute approximately 14.5 acres of habitat loss in the long term and up to approximately 1,388 acres of effective wildlife habitat loss in the planning area. The proposed action would contribute to cumulative habitat fragmentation within the planning area from the construction of approximately 1.1 miles of new road. Approximately 2.4 miles of existing roads would be upgraded and would not contribute to habitat fragmentation. The proposed action is not expected to result in significant cumulative impacts when added to past, present, and future actions.

3.5.3 Impacts from Alternative C

Direct and Indirect Impacts

Alternative C would result in the short-term loss of approximately 53.7 acres of undisturbed vegetation and the removal of 187 piñon and juniper trees. There would be a long-term loss of approximately 13.4 acres of undisturbed vegetation. Alternative C would have disturbance impacts to wildlife similar to those described under Alternative B, including effective habitat loss of approximately 1,120 acres.

Cumulative Impacts

Cumulative impacts to wildlife would be similar to those described under Alternative B. Alternative C would cumulatively contribute approximately 13.4 acres of direct habitat loss and up to approximately 1,120 acres of indirect wildlife habitat loss in the planning area. Alternative C would contribute to cumulative habitat fragmentation within the planning area from the construction of approximately 0.4 mile of new road. Approximately 4.2 miles of existing roads would be upgraded and would not contribute to habitat fragmentation.

3.6 Special Management Species

3.6.1 Affected Environment

In accordance with BLM Manual 6840, the BLM manages certain sensitive species not federally listed as threatened or endangered in order to prevent or reduce the need to list the species as threatened or endangered in the future.

The Lybrook E15-2208 pipeline ROW under Alternative C would be located on State of New Mexico and BLM managed lands. A portion of the existing road that would be upgraded is located on Navajo Nation Tribal Trust land. The State of New Mexico maintains a list of threatened or endangered species potentially occurring in San Juan County.

Table 3-8 lists the BLM special management species that have the potential to occur in the analysis area. The table also includes state-listed species. All of the species, except the Gunnison's prairie dog (*Cynomys gunnisoni*), have the potential to occur throughout the Alternative B project footprint. These species may also occur in the Alternative C project footprint, as well as Gunnison's prairie dog, which has the potential to occur in the Lybrook E15-2208 project footprint under Alternative C. A Biological Survey Report for each proposed project component and the alternative were prepared and are provided in Appendix D. The Biological Survey Reports provide the basis for the findings listed in Table 3-8.

Table 3-8. Special status species with potential to occur in the analysis area

Species	Conservation Status	Habitat Associations
Mammals		
Gunnison's prairie dog (*Cynomys gunnisoni*)	BLM Sensitive	Primarily inhabits grass/forb/shrub habitats on abandoned land, valley floors, stream valleys, mountain meadows, high-elevation plateaus and benches, and intermountain valleys.
Townsend's big-eared bat (*Corynorhinus townsendii*)	BLM Sensitive	Roosts mostly in caves or mines; can roost in abandoned buildings at night. In summer, this species occurs widely across the state and can be found over desert scrub, desert-mountains, oak-woodland, piñon-juniper, and coniferous forests.
Birds		
American peregrine falcon (*Falco peregrinus anatum*)	BLM Sensitive State Threatened	Located in rugged terrain with rocky cliffs and canyons (30 to over 1,000 feet high), typically adjacent to rivers, lakes, or streams. Urban areas with towers and buildings also inhabited.
Chestnut-collared longspur (*Calcarius ornatus*)	BLM Sensitive	A native prairie specialist. Winters in grasslands, deserts, and plateaus dominated by low grasses and forbs, where most vegetation is less than 2 feet high.
Bendire's thrasher (*Toxostoma bendirei*)	BLM Sensitive	Typically inhabits sparse desert shrubland and open woodland with scattered shrubs.
Burrowing owl (*Athene cunicularia*)	BLM Sensitive	Rarely digs its own burrows and is typically associated with prairie dog colonies. Found in dry, open, short-grass, treeless plains. Uses areas that include shrubs, such as four-wing saltbush and rabbit-brush.
Ferruginous hawk (*Buteo regalis*)	BLM Sensitive	Flat or rolling terrain in grasslands, shrub-steppes, deserts, and badlands; prefers elevated nest sites (e.g., buttes, utility poles, trees, and ledges).
Golden eagle (*Aquila chrysaetos*)	BLM Sensitive	In the western U.S., mostly open habitats in mountainous, canyon terrain. Nests primarily on cliffs and in trees.
Piñon jay *(Gymnorhinus cyanocephalus)*	BLM Sensitive	Primarily associated with piñon-juniper habitat.
Prairie falcon (*Falco mexicanus*)	BLM Sensitive	Arid, open regions of grassland or scrub vegetation with cliff formations that are at least 30 feet high. Breeding cliffs

Species	Conservation Status	Habitat Associations
		sometimes are in semi-open regions with scattered conifer trees and occasionally dense woodlands.
Plants		
Aztec gilia (*Aliciella formosa*)	BLM sensitive	Salt desert scrub communities in soils of the Nacimiento Formation (5,000 to 6,000 feet).
Brack's hardwall cactus (*Sclerocactus cloveriae* ssp. *brackii*)	BLM sensitive	Sandy clay of the Nacimiento Formation in sparse shadscale scrub (5,000 to 6,000 feet).

Three special-status species were observed within the analysis area: Gunnison's prairie dog, piñon jay *(Gymnorhinus cyanocephalus)*, and Brack's hardwall cactus (*Sclerocactus cloveriae* ssp. *brackii*). Table 3-9 provides the number of individual Brack's hardwall cacti that were recorded during project-related biological surveys.

Table 3-9. Brack's hardwall cactus observations

	Number and Location of Cacti
Lybrook E11-2208	6 located within the proposed well pad
Lybrook E12-2208	10 located on the proposed access and pipeline

3.6.2 Impacts from Alternative B: Proposed Action

Direct and Indirect Impacts

The analysis area provides potential foraging habitat for Townsend's big-eared bat (*Corynorhinus townsendii*). No potential roosting habitat would be removed by the proposed action. Impacts to this bat species would be limited to avoidance of the area during nighttime drilling or completion activities when they may incidentally forage in the area. These impacts would be short term and limited to summer months when the species could be in the analysis area.

The analysis area provides suitable nesting habitat for Bendire's thrasher (*Toxostoma bendirei*). The proposed action would result in modification of approximately 54.2 acres of undisturbed desert scrub and very open canopy wooded habitat. There would be a long-term loss of approximately 14.5 acres of suitable habitat for Bendire's thrasher. Should construction and drilling occur during the breeding season, Bendire's thrasher would likely avoid the area. Pre-construction surveys would be conducted to identify any active nests within the proposed disturbance area if construction should occur between May 15 and July 31. This design feature would avoid adverse impacts to nesting Bendire's thrasher.

The project area provides suitable wintering habitat for chestnut-collared longspur (*Calcarius ornatus)*. Impacts to chestnut-collared longspur would include avoidance of the area during construction and drilling if it occurs during the winter months and the long-term loss of approximately 14.5 acres of suitable wintering habitat.

Impacts to piñon jay include the removal of approximately 142 piñon and juniper trees within the project area. It would take decades for trees to re-establish in the project area. Impacts to piñon jay would result from the long-term modification of approximately 14.5 acres of dispersal habitat between habitat patches. There would be a long-term loss of approximately 3 acres of very open canopy wooded habitat. The removal of trees would also result in a long-term loss of food source for piñon jay. Additional impacts could include avoidance of the project area during construction and drilling, due to an increase in human, equipment and vehicle activity and associated noise.

The analysis area contains open desert scrub, providing potential foraging habitat for golden eagle (*Aquila chrysaetos*), ferruginous hawk (*Buteo regalis*) American peregrine falcon (*Falco peregrinus anatum*), and prairie falcon (*Falco neomexicanus*). No potential nesting habitat for these species would be removed or modified by the proposed action. No raptor nests were identified within a 1/3-mile radius of the analysis area. Direct impacts would include the modification of approximately 54.2 acres of undisturbed foraging habitat. Approximately 142 piñon and juniper trees of various ages and sizes would be removed by the proposed action, resulting in a long-term loss of potential perch sites. This loss of perch habitat is not expected to adversely affect the foraging abilities of these raptor species, given the abundance of suitable sites in the surrounding area. After reclamation, there would be a short- to long-term change in vegetation density and composition. This could affect the prey base for these raptors. Approximately 14.5 acres of potential foraging habitat would be converted to industrial use in the long term. Raptors may avoid the analysis area during construction, drilling, and operation due to disturbance and activity from human and vehicle presence and associated noise.

There are approximately 5.2 acres of potential habitat for Aztec gilia on the proposed Lybrook E11-2208 and Lybrook E12-2308 well pads projects. The remaining proposed action components do not provide potential habitat for this species based on the vegetation community, percent ground cover, and soil characteristics. The proposed action would result in the long-term modification of approximately 5.2 acres unoccupied Aztec gilia habitat. No Aztec gilia were observed in the analysis area.

No potential habitat for Brack's hardwall cactus occurs on the proposed Lybrook A03-2208 or the Lybrook E15-2208 well pads, access roads or pipelines. There is suitable and occupied habitat on the Lybrook E11-2208, Lybrook D12-2208, and Lybrook E12-2208 well pads, access roads, and pipeline ROWs. A total of approximately 27 acres of suitable or occupied habitat occurs in the analysis area. The proposed action would result in the long-term modification of approximately 27 acres of undisturbed potential habitat for the Brack's hardwall cactus, some of which is currently occupied. A total of 16 individual Brack's hardwall cacti were recorded during biological surveys in the proposed Lybrook E11-2208 and Lybrook E12-2208 project areas. The five cacti on the Lybrook E11-2208 well pad are location in the construction zone and may be avoided by erecting temporary fencing during construction and drilling. There are approximately eight cacti located on the edge of the proposed pipeline ROW for the Lybrook E12-2208 which may be avoided by erecting temporary fencing during construction. Two cacti located on the proposed Lybrook E12-2208 would be removed by construction of the proposed access road.

Cumulative Impacts

The BLM/FFO would continue to manage non-federally listed species according to BLM policies and guidelines, with the goal of contributing to the conservation of these species to reduce the potential for

being listed under the ESA of 1973, as amended (USDI/BLM 2003a, 4-111). For reasonably foreseeable actions on federal lands, direct impacts to nesting special status raptor species would be avoided through the BLM's siting criteria. Development on federal and private lands would result in the removal or modification of potential foraging habitat. These effects would be related to availability of undisturbed habitat and the amount of disturbance that would occur within the analysis area.

The cumulative impacts analysis area for assessing impacts to wildlife is the Escavada Wash watershed. Reasonably foreseeable development within the Escavada Wash watershed may include an estimated additional 326 oil and gas wells and related facilities and 39 miles of new roads based on the assumption that 196 new well pads could be developed in the watershed. Surface-disturbing activities associated with these actions may directly affect an estimated 2,116 acres of special status species habitat. The proposed action would result in the long-term loss of 14.5 acres of undisturbed habitat for Bendire's thrasher, chestnut-collared longspur, piñon jay, golden eagle, peregrine falcon, ferruginous hawk, and prairie falcon. Approximately 5.2 acres of unoccupied Aztec gilia habitat and 27 acres of potential and occupied Brack's cactus habitat would be affected for the long term. Other reasonably foreseeable actions within the planning area that could impact special status species would include livestock grazing, agriculture, commercial and residential development, mining, and vegetation management. The proposed action would not contribute appreciably to a cumulative habitat loss for BLM special management species within the planning area.

3.6.3 Impacts from Alternative C

Direct and Indirect Impacts

If this alternative is selected, and the applicant is required to obtain a ROW grant from the Bureau of Indian Affairs (BIA) for the existing road that would be upgraded, the applicant would consult with the Navajo Nation Department of Fish and Wildlife and would complete a biological evaluation to analyze impact to Navajo endangered species with the potential to occur within the analysis area. Should adverse impacts be identified, mitigation measures to be developed and implemented to minimize potential impacts.

Under Alternative C, impacts to Townsend's big-eared bat would be the same as those described under Alternative B (i.e., avoidance of potential foraging habitat during nighttime activities).

An approximate 0.06-acre prairie dog town occurs within the alternative Lybrook E15-2208 project area. The small town appeared to be active during the biological surveys. Impacts to prairie dogs would include the potential for mortality during construction of the proposed pipeline. However, prairie dogs would be expected to disperse temporarily from the project area for the duration of construction and reclamation. Prairie dogs would be expected to return to the area following reclamation. There would be a short-term loss of approximately 0.06 acre of suitable habitat for Gunnison's prairie dogs.

Prairie dog burrows provide potential nesting habitat for burrowing owl (*Athene cunicularia*). No sign of burrowing owl occupancy was observed in the analysis area during the biological surveys. However, the surveys were conducted during a time of year when this species would not be present. The potential for disturbance and nest destruction would be greatest between the months of March and August. If construction of the Lybrook E15-2208 under Alternative C is scheduled during the nesting period

between April 1 and July 31, surveys for active burrowing owl burrows would be required. Should active nests be identified, no disturbance within a 50-meter radius would be allowed from April 1 to August 15. The proposed action would result in the long-term loss of approximately 0.06 acres of potential burrowing owl nesting habitat.

A total of 53.7 acres of Bendire's thrasher habitat and chestnut-collard longspur wintering habitat would be modified in the short term. There would be long-term impacts to approximately 13.4 acres that would be converted to an industrial use during operation. Approximately 187 piñon and juniper trees would be removed.

Impacts to piñon jay include the removal of approximately 187 piñon and juniper trees within the project area. It would take decades for trees to re-establish in the project area. Impacts to piñon jay would result from the long-term modification of approximately 13.4 acres of dispersal habitat between habitat patches. There would be a long-term loss of approximately 5 acres of very open canopy wooded habitat. The removal of trees would also result in a long-term loss of food source for piñon jay. Additional impacts could include avoidance of the project area during construction and drilling, due to an increase in human, equipment and vehicle activity and associated noise.

Alternative C would modify approximately 53.7 acres of undisturbed raptor foraging habitat in the short term, and 13.4 acres would be lost in the long term.

Under Alternative C, impacts to Aztec gilia and Brack's cactus would be the same as those described under Alternative B.

Cumulative Impacts

Cumulative impacts would be the similar as those described under Alternative B.

3.7 Migratory Birds

3.7.1 Affected Environment

Under the MBTA and Executive Order 13186, federal agencies are required to consider impacts to migratory birds from management activities. The BLM migratory bird conservation policy for the planning area is detailed in Instruction Memorandum No. NM-F00-2010-001 (USDI/BLM 2010). This management policy establishes a consistent approach for addressing migratory bird populations and habitats when by making project level implementation decisions. The management policy also outlines best management practices and design features to avoid or minimize impacts.

While all migratory songbirds are protected by law, certain species have been determined to be at greater risk than others. More than 350 avian species occur in San Juan County and the surrounding area administered by the BLM/FFO. Data collected through breeding bird surveys coordinated by the U.S. Fish and Wildlife Service (USFWS) and private sector efforts have provided the basis for the New Mexico Partners in Flight (NMPIF) organization to develop bird "watch lists" and the USFWS list of Birds of Conservation Concern. The NMPIF has also identified priority species of birds by habitat type

for the state of New Mexico. The FFO area lies within the Colorado Plateau physiographic region, as identified by the NMPIF. The analysis area contains the Great Basin desert shrub (sage-grass) habitat.

The Bird Conservation Plan developed for the State of New Mexico by the NMPIF lists the sage thrasher (*Oreoscoptes montanus*) and sage sparrow (*Amphispiza belli*) as a "highest priority" species for conservation in the Great Basin desert shrub habitat. Most of the priority bird species identified by the NMPIF also occur on the USFWS Division of Migratory Bird Management list of "Birds of Conservation Concern 2008" within the Bird Conservation Region 16–Southern Rockies/Colorado Plateau. Birds included on this list are those "species, subspecies, and populations of all migratory non-game birds that, without additional conservation actions, are likely to become candidates for listing under the ESA of 1973" (USFWS 2008).

No nests were recorded within the analysis area during the biological surveys.

3.7.2 Impacts from Alternative B: Proposed Action

Direct and Indirect Impacts

Executive Order 13186 calls for increased efforts to fully implement the MBTA. In keeping with this mandate, the BLM consulted the NMPIF Bird Conservation Plan for the State of New Mexico and the USFWS list of Birds of Conservation Concern. A review of these documents—specifically as they pertain to the Colorado Plateau physiographic area—indicates there are eight avian species with a known range of distribution in the BLM/FFO planning areas that utilize the sage-grass habitat and three avian species that utilize the piñon-juniper habitat type that occur on the NMPIF "Highest Priority" and USFWS "Birds of Conservation Concern 2008" lists.

Various types of perturbations and/or anthropogenic activity may affect these species. These species and a brief assessment of the effects of the proposed action on their habitat are provided in Table 3-10.

Table 3-10. Migratory bird species of concern potentially occurring within the analysis area and effects from the proposed action

Species	Habitat Type	Effects
Grasshopper sparrow (*Ammodramus savannarum*)	Sage-grass	May be positively affected due conversion to grassland
Sage sparrow[1] (*Amphispiza belli*)	Sage-grass	May be positively affected due conversion to grassland
Burrowing owl (*Athene cunicularia*)	Sage-grass	No effect; nests in abandoned prairie dog burrows
Ferruginous hawk (*Buteo regalis*)	Sage-grass/piñon-juniper interface	No effect; no suitable habitat in the analysis area
Mountain plover (*Charadrius montanus*)	Sage-grass	No effect; no suitable habitat in the analysis area
Long-billed curlew (*Numenius americanus*)	Sage-grass	May be positively affected due to conversion to grassland
Sage thrasher[1] (*Oreoscoptes montanus*)	Sage-grass	May be positively affected due to conversion to grassland
Bendire's thrasher	Sage-grass	May be positively affected due to

Species	Habitat Type	Effects
(*Toxostoma bendirei*)		conversion to grassland
Juniper titmouse (*Baeolophus ridgwayi*)	Piñon-juniper	Secondary cavity nester; some loss of nesting habitat
Piñon jay (*Gymnorhinus cyanocephalus*)	Piñon-juniper	Colony nester in piñon; loss of piñon would impact
Gray vireo (*Vireo vicinior*)	Piñon-juniper	Nests in juniper; reduction of juniper would impact

[1] "High Priority" bird species that are on the NMPIF Priority Species List, but not on the USFWS Birds of Conservation Concern 2008 list. Source: NMPIF 2007.

Direct impacts to migratory birds would include the disturbance and modification of approximately 54.2 acres of undisturbed desert scrub vegetation and piñon-juniper woodland vegetation. The proposed action would result in the removal of approximately 142 piñon and juniper trees. There would be a long-term loss of approximately 14.5 acres of habitat that would be converted to an industrial use. Approximately 1.1 miles of new roads would be added to the transportation network, resulting in habitat fragmentation and an increase in edge habitat. Migratory birds would be impacted by disturbance during construction, drilling, and completion; these impacts would be short term. During production, impacts to migratory birds would be related to an increase in habitat fragmentation and disturbance from periodic traffic for maintenance and fluid removal.

Impacts to migratory birds would be greater should construction occur during the breeding season of May 15 through July 31. Construction, drilling, and completions during this period could result in nest destruction or may cause some nest abandonment in adjacent areas. Pre-construction surveys would be conducted to identify any active nests should construction occur during the breeding season. Migratory birds could come into contact with chemicals or fluids stored on-site. Open pits would be netted and vent caps placed on all open pipes to prevent bird entry and nesting. Any spills would be promptly cleaned up. Although individual migratory birds could be impacted by the proposed action, no population level impacts are expected.

Cumulative Impacts

The cumulative impacts analysis area for assessing impacts to migratory birds is the Escavada Wash watershed. Reasonably foreseeable development within the Escavada Wash watershed may include an estimated additional 326 oil and gas wells and related facilities, and 39 miles of new roads based on the assumption that 196 new well pads could be developed in the watershed. Surface-disturbing activities associated with these actions may directly affect an estimated 2,116 acres of wildlife habitat with a long-term loss of approximately 489 acres of habitat. Other reasonably foreseeable actions within the watershed that could impact migratory birds would include livestock grazing, commercial and residential development, mining, wildfire, and vegetation management. Cumulative impacts to migratory birds from the proposed action would result from the long-term changes in density and composition of approximately 14.5 acres of Great Basin desert scrub habitat. The proposed action would contribute to cumulative habitat fragmentation within the watershed from the construction of approximately 1.1 miles of new road. The proposed action would not result in significant impacts to migratory birds when combined with past, present, and future actions.

3.7.3 Impacts from Alternative C

Direct and Indirect Impacts

Impacts to migratory birds would be similar to those of the Alternative B. Alternative C would result in the modification of approximately 53.7 acres of Great Basin desert scrub and open canopy piñon-juniper woodland habitat. There would be a long-term loss of approximately 13.4 acres of habitat, which would be converted to an industrial use. Pre-construction surveys would be conducted to identify any active nests within the proposed project area should construction occur between May 15 and July 31.

Cumulative Impacts

Cumulative impacts to migratory birds from the proposed action would result from the long-term changes in density and composition of approximately 13.4 acres of Great Basin desert scrub habitat and open canopy piñon-juniper woodland. The proposed action would contribute to cumulative habitat fragmentation within the planning area from the construction of approximately 0.4 mile of new road. The proposed action would not result in significant impacts to migratory birds when combined with past, present, and future actions.

3.8 Cultural Resources

3.8.1 Affected Environment

The proposed analysis area is located within the archaeologically rich San Juan Basin of northwestern New Mexico. In general, the prehistory of the San Juan Basin can be divided into five major periods: PaleoIndian (ca. 10000 B.C. to 5500 B.C.), Archaic (ca. 5500 B.C. to A.D. 400), Basketmaker II-III and Pueblo I-IV periods (A.D. 1 to 1540), and the historic (A.D. 1540 to present) that includes Native American as well as later Hispanic and Euro-American settlers. A detailed description of these various periods and select phases within each period is provided in the Farmington PRMP/FEIS (USDI/BLM 2003a).

The entire area of potential effect for the proposed action components was archaeologically surveyed by LAC at a BLM Class III level (100 percent). Reports were prepared and submitted to the BLM in accordance with the *Procedures for Performing Cultural Resources Fieldwork on Public Lands in the Area of New Mexico BLM Responsibilities* (USDI/BLM 2005). The cultural resource survey results are included in five reports (LAC Report 2014-2nn, LAC Report 2013-6i, LAC Report 2014-2j, LAC 2014-2i, and LAC Report 2014-2n).

Prior to all field surveys of the proposed action, a Class I investigation of records at the BLM/FFO and an online search of Archeological Records Management Services was conducted to determine if any sites have been recorded within 0.25 mile of the survey area.

The proposed Lybrook A03-2208 well pad, access road and pipeline are evaluated in the LAC Report 2014-2nn (BLM 2014(IV)033F). There are three previously recorded sites occurring within 0.25 mile of the proposed project. Two new archaeological sites were encountered within the survey area. One site is recommended as eligible for nomination to the NRHP and the second is of undetermined National Register eligibility. Neither of these sites are located within the area of potential effect.

The proposed Lybrook D12-2208 well pad, access road and pipeline are evaluated in the LAC Report 2013-6i (BLM 2014(IV)027F). No previously recorded sites were identified within 0.25 mile of the proposed project, and no cultural resources were identified during field surveys

The proposed Lybrook E11-2208 well pad, access road, and well-tie pipeline are addressed in LAC Report 2014-2j (BLM 2015(I)007F). There are three previously recorded sites within 0.25 mile of the proposed project components. Three new sites were encountered and are recommended for nomination to the NRHP. None of these sites are located within the area of potential effect.

The proposed Lybrook E12-2208 well pad, access road, and well-tie pipeline are addressed in LAC Report 2014-2i (BLM 2015(I)009F). There is one previously recorded site within 0.25 mile of the proposed project components. Five new sites were encountered, and four of these sites are either recommended as eligible for the NRHP or as needing data before an eligibility recommendation can be made. None of these sites are located within the area of potential effect.

The proposed Lybrook E15-2208 well pad, access road, and well-tie pipeline are addressed in LAC Report 2014-2n (BLM 2015(I)014). There are six previously recorded sites within 0.25 mile of the proposed project components. Six new sites were encountered and all of these sites are either recommended as eligible for the NRHP or as needing data before an eligibility recommendation can be made. None of these sites are located within the area of potential effect.

3.8.2 Impacts from Alternative B: Proposed Action

Direct and Indirect Impacts

Cultural resources tend to degrade over time from natural forces; however, many survive for hundreds or thousands of years. Any land-disturbing activity can disturb, damage, or uncover cultural resources. Direct impacts normally include alterations to the physical integrity of a historic property. If a historic property is significant for other than its information potential, direct impacts may also include the introduction of audible, atmospheric, or visual elements that are out of character for the property. A potential indirect impact from the proposed action, particularly in undeveloped areas is the increase in human activity or access to the area with an increased potential of unauthorized damage to historic properties. Historic properties (i.e., National Register eligible/listed) are being avoided with the implementation of design features such as but not limited to, reduction of construction areas, temporary barriers, and site monitoring. These design features are detailed in the BLM Cultural Resource Record of Review attached to the COA in the APDs and ROW grants. The proposed action is not known to physically threaten any traditional cultural property, prevent access to sacred sites, prevent the possession of sacred objects, or interfere or otherwise hinder the performance of traditional ceremonies/rituals. The proposed action would have no direct or indirect impact on historic properties (no historic properties affected).

Cumulative Impacts

The cumulative impacts analysis area for cultural resources is the Escavada Wash watershed. There would be no negative cumulative impact on known historic properties as they are being avoided by relocating the surface disturbing components of the proposed action away from the property. A positive cumulative effect is the additional scientific information yielded by the archaeological surveys. Risks of

impacting unknown (i.e., buried) historic properties is normally negligible as cultural resources "discoveries" during surface disturbing components of a proposed action are infrequent in the FFO. Since fiscal year 2000, 28 discoveries have occurred in association with 21,290 actions (e.g., road, well, pipeline, etc.), or 1:760. During that period 153,626 acres of land were inspected for cultural resources, with an average of 7.2 acres per action and one discovery per 5,472 acres per discovery. All authorizations (e.g., APDs, ROWs) have stipulations, under penalty of law, requiring the reporting of and avoidance of further disturbing cultural discoveries during a proposed action. Where the risk of discoveries can be reasonably expected (e.g., ≤ 100 feet of a known historic property or in environmental settings known or suspected to be conducive to buried sites), archaeological monitoring by a qualified and permitted archaeologist during initial disturbance (e.g., blading, trenching) is normally required. If buried historic properties are discovered, collaborative steps are taken to protect them in place or recover their important information.

3.8.3 Impacts from Alternative C

Direct and Indirect Impacts

If this alternative is selected, the applicant would need to complete a cultural survey of the Lybrook E15-2208 alternative access road and pipeline alignment. Historic properties (i.e., National Register eligible/listed) would be avoided with the implementation of design features such as, but not limited to, reduction of construction areas, temporary barriers, and site monitoring.

Cumulative Impacts

Cumulative impacts would be the same as those described under Alternative B.

3.9 Paleontological Resources

3.9.1 Affected Environment

The proposed project is located within the paleontological rich area of the San Juan Basin of northwestern New Mexico. The BLM uses the Potential Fossil Yield Classification (PFYC) system to identify areas with a high potential to produce significant fossil resources (USDI/BLM 2007). The BLM's PFYC system is a predictive modeling tool developed to provide baseline guidance for assessing and mitigating paleontological resources. It is intended to be used at an intermediate point in analyses and to assist in determining the need for further mitigation assessment or actions. This system has ranked all lands within the BLM/FFO planning area with a Class 5 designation. Class 5 designations are described as being "Very High Potential" paleontological resource areas, thus requiring an assessment at the project level.

The BLM/FFO recognized eight paleontological specially designated areas in the RMP in order to preserve important paleontological resources for scientific study, protection, and other public benefits (USDI/BLM 2003b, page 4-117). The BLM determined that these areas require special management attention to protect and prevent irreparable damage to important paleontological resources. The proposed project is located in the Lybrook Fossil Area SDA. The Lybrook Fossil Area is one of the earliest paleontology study areas found in the San Juan Basin, with E.D. Cope working there in 1874 (USDI/BLM 2003a: Appendix C, p. C87). The Lybrook Fossil Area is managed by the BLM, which

contains approximately 26,000 acres of land within its boundary. The explicit management goal for the area is to promote scientific study and protect fossil resources. Pursuant to the BLM RMP (USDI/BLM 2003a), ROWs in the SDA are granted on a case-by-case basis with stipulations that protect paleontological values.

3.9.2 Impacts from Alternative B: Proposed Action

Direct and Indirect Impacts

The proposed project was assessed individually based on analyses conducted for the BLM/FFO 2003 RMP using the BLM's PFYC system, geographic information system-based locality data, known paleontological locality information, existing paleontological reports for the area, aerial photos, soils maps, existing reports, and scientific publications for the area. BLM personnel took part in the siting of project components.

Effects to fossil localities could result from ground-disturbing activities or disturbance of the stratigraphic context in which they are located. Alterations to the physical integrity of bedrock or potentially fossil-yielding alluvium may occur and would have a direct effect on unidentifiable or irretrievable fossil resources. The proposed action also could create indirect impacts to areas by changing erosion patterns. Additionally, an increase in human activity in the area could result in accessibility to remote areas and could lead to looting or vandalism of paleontological resources in the area.

Cumulative Impacts

The proposed action is not expected to impact significant paleontological resources or contribute to cumulative impacts.

3.9.3 Impacts from Alternative C

Direct and Indirect Impacts

Alternative C would have the same impacts to paleontological resources as Alternative B

Cumulative Impacts

Cumulative impacts would be the same as those described under Alternative B.

3.10 Traffic and Transportation

3.10.1 Affected Environment

The transportation infrastructure in the proposed project area includes an extensive road network used to access oil and gas development facilities, residences, and local commercial establishments. These roads were built and are maintained by the New Mexico Department of Transportation (NMDOT), private industry, and Sandoval County depending on the land ownership and agreements among these entities.

The primary routes accessing the analysis area are U.S. Highway 550, Indian Service Route 7061 (Star Lake Road), County Road 7950 (the road into Chaco Culture National Historical Park), and several

unmaintained dirt roads and two-tracks. No roads that would be used to access the analysis area components carry weight limitations.

Chaco Culture National Historical Park receives approximately 40,000 visitors a year. These visitors enter the park by utilizing County Road 7950. Visitors identified aspects that added to or detracted from their experience at Chaco Culture National Historical Park. Chaco Culture National Historical Park's remoteness and ability to explore the features of the park added to their experience (Freimund and Dalenberg 2010).

A recent study conducted by TRIP (TRIP 2013) shows an increase of vehicle miles traveled in New Mexico by 58 percent between 1990 and 2011. The report also suggests that vehicle miles traveled in New Mexico will increase 40 percent by 2030. Traffic data are not available for BLM or USDI BIA roads. Recent traffic counts on U.S. Highway 550 by NMDOT are listed in Table 3-11 in Average Annual Daily Traffic (AADT) levels (NMDOT 2014). The Rio Arriba/Sandoval County line is less than 1 mile west of the turnoff of the western extent of the analysis area. The junction of U.S. Highway 550 and the Lybrook Refinery entrance is located approximately 5.5 miles west of the western extent of the analysis area

Traffic levels on U.S. Highway 550 at the Sandoval/Rio Arriba county line doubled in average annual traffic levels between 2011 and 2013, and an increase of approximately 13 percent occurred at the junction of U.S. Highway 550 and the Lybrook Refinery Entrance. The greatest change in AADT was a 46 increase in eastbound traffic.

Table 3-11. Traffic counts of U.S. Highway 550 near the project area

Year	Junction Lybrook Refinery Entrance	Sandoval/ Rio Arriba County Line
2011	5,030	2,622
2012	5,196	2,686
2013	5,665	5,249

3.10.2 Impacts from Alternative B: Proposed Action

Direct and Indirect Impacts

In accordance with the Surface Use Plan of Operations for the well pad, existing roads would be maintained in the same or better condition as existed prior to the commencement of operations, and maintenance would continue until final abandonment and reclamation of the well. Encana would inspect and maintain the roads as outlined in the Surface Use Plan of Operations. Under the proposed action, approximately 2.4 miles of existing road would be upgraded.

The proposed action would not utilize County Road 7950 and would not impact the visitor experience from the County Road going into the Chaco Cultural National Historical Park.

Approximately 1.1 miles of new road would be constructed. As with existing roads, Encana would be responsible for road maintenance until the wells are plugged and abandoned.

Workers would be on-site 10 hours a day for 6 days a week and for the duration of well pad and access road construction. During drilling, workers would be on-site 24-hours a day for up to 21 days per well (typically 10 to 12 days). Except for flaring, completion activities would occur during daylight hours only. Traffic levels within the project area would increase for the duration of construction, drilling, completion, pipeline construction, and reclamation.

Vehicles accessing the proposed well pad would include light-duty trucks, such as pick-ups and welding rigs, and heavy-duty vehicles, such as water trucks, 2-ton bobtails, and semi-trucks. Depending on each stage of the proposed action (i.e., construction, drilling, completion), traffic levels could vary widely. Generally, during mobilization/demobilization, there would be an increase in average daily traffic above what is estimated for most stages of the proposed action. During mobilization/demobilization, equipment, tanks, pipe, sand, and other materials would be moved in/out of the well pad area; therefore, most of the traffic would be heavy-duty vehicles. Mobilization/demobilization would normally take 2 days for each process and would occur at the stage of the project (e.g., construction, drilling, etc.). The highest increase in daily traffic levels would occur during the completion stage during which trucks hauling in sand, water, and other materials would be accessing the site. Table 3-12 lists the activity, number of days to complete each activity, and number of daily and round trips that are estimated to occur under the proposed action. Traffic estimates are based on a conservative timeframe for each stage and the high end of the anticipated range of trips that could occur.

Table 3-12. Estimated traffic levels resulting from one well

Activity	Length (days)	Total Number Round Trips	Average Daily Round Trips
Construction	18	40	2
Drilling	12	354	30
Completion	10	1240	124
Flow testing	20	489	24
Well-tie pipeline construction	21	180	9
Reclamation	30	257	9

Based on the AADT measured at the Sandoval/Rio Arriba county line on U.S. Highway 550 (Table 3-11), the proposed action would increase daily traffic levels on U.S. Highway 550 by less than 1 percent during construction and reclamation and by about 2 percent during completion when the highest traffic levels would occur. Roads that spur from U.S. Highway 550 and lead to the proposed well pad would be subject to a greater increase in traffic levels since these roads have lower traffic levels than the highway. Increased traffic, particularly heavy trucks, would result in wear and tear on the dirt roads, along with increased maintenance of the road network in the proposed project area. These impacts would be short term for the duration of construction.

Area residents or other motorists may experience delays other traffic disruptions during the work week depending on the stage of development of the proposed action. These impacts would be greater for those residents living within 1,000 feet of the proposed location and along the access routes into the locations. Increased traffic may pose collision hazards for workers and public motorists. Fugitive dust may impair worker and motorist visibility. These impacts would be short term, occurring for the duration of

construction, drilling, and completion activities. All road crossings would be manned with flaggers and spotters during heavy construction and during mobilization and demobilization. Orange flagging and barriers would be put in place to restrict public access to the work site. Water would be applied to roads, if needed, to minimize fugitive dust. Following reclamation, existing roads would be rehabilitated if needed.

During production, there would be light- and heavy-duty vehicles accessing the proposed wells for monitoring, maintenance, and liquid removal. Initially the wells would be expected to produce water, which would decline rapidly in volume over approximately 6 months. Produced water would be stored on-site in tanks and removed via truck to a disposal facility. Table 3-13 lists the number of truck trips and average daily/monthly trips per well for a 3-year period. In addition, one pickup would access each well pad daily for the duration of production

Table 3-13. Average daily truck trips per well for 3-year period

Timeframe	Truck Trips	Average Daily Trips
Month 1	73	2
Month 2	63	2
Month 3	48	2
Month 4	39	1
Month 5	34	1
Month 6	30	1
Month 7-12	28	1 per month
Year 2	19	1.5 per month
Year 3	12	1 per month

Cumulative Impacts

The cumulative impacts analysis area is the Escavada Wash watershed. Encana personnel would access the well pads on a regular basis (up to six times per week) to inspect and monitor the locations. Trucks would also access the locations on a regular basis to remove liquids. The RFD projected approximately 39 miles of new road within the Escavada Wash watershed. The proposed action would add about 1.1 miles of new road to the overall cumulative disturbance in the area. This increase to the road network and the anticipated increase in traffic levels in the project area would result in cumulative impacts within the scale of development and effects analyzed in the 2003 PRMP/FEIS (USDI/BLM 2003a) and estimated in the RFD (Engler et al. 2014) when added to past, present, and reasonably foreseeable activities.

3.10.3 Impacts from Alternative C

Direct and Indirect Impacts

Under Alternative C, the Lybrook E15-2208 project area would be accessed by utilizing County Road 7950 (the road into Chaco Culture National Historical Park) for about a half mile. The road going into Chaco Culture National Historical Park is culturally and publicly sensitive. Chaco Culture National

Historical Park receives approximately 40,000 visitors a year. These visitors enter the park by utilizing County Road 7950. Visitors identified aspects that added to or detracted from their experience at Chaco Culture National Park. Culture National Historical Park's remoteness and ability to explore the features of the park added to their experience (Freimund and Dalenberg, 2010). Although this alternative only uses County Road 7950 for a short distance, the increased traffic (for the life of the wells) may disturb the park's visitors.

Approximately 4.2 miles of existing road would be upgraded and approximately 0.4 mile of new road would be constructed under this alternative. Additionally, there is a home located in the SW corner of Section 9 on Tribal lands. The home is located approximately ¼ mile off the road that would be upgraded; the residents would have increased traffic near their home from this alternative. The remaining impacts from the amount of traffic for construction, drilling, completion, reclamation, and operation, and the types of impacts on roads and area residents would be the same as those described under Alternative B.

Cumulative Impacts

The proposed action would add about 1.1 miles of new road to the overall cumulative disturbance in the area. This increase to the road network and the anticipated increase in traffic levels in the project area would result in cumulative impacts within the scale of development and effects analyzed in the 2003 PRMP/FEIS (USDI/BLM 2003a) and estimated in the RFD (Engler et al. 2014) when added to past, present, and reasonably foreseeable activities.

3.11 Livestock Grazing

3.11.1 Affected Environment

There are 208 grazing allotments managed by the FFO with approximately 390 grazing authorizations that permit primarily cattle and sheep grazing within in the FFO boundaries. A very limited number of these allotments also permit goats and occasionally horses for ranch use only. Allotments range in size from approximately 20 to over 100,000 acres. For all 208 allotments, the FFO permits a total of approximately 119,162 active animal unit months (AUMs), of which approximately 9,228 are Navajo Free Use. Under the Taylor Grazing Act of 1937, allotments can be permitted through Section 3 (permits issued on public lands within grazing districts established by the Act) or Section 15 (grazing leases issued on public lands outside the grazing districts established by the Act). Of the 208 FFO grazing allotments, 143 are Section 3 allotments, and 65 are Section 15 allotments. There are approximately 325 authorizations on Section 3 allotments, of which 3 are very large Navajo community allotments. There are 65 authorizations on the Section 15 allotments. For the Section 15 allotments, 30 are administered by the BIA under a Memorandum of Understanding; 5 are managed under the Navajo Nation Tribal Ranches program, and 30 are located near Lindrith, New Mexico. There are an additional 21 allotments that are within or overlap the FFO boundary that are managed by the Rio Puerco Field Office (RPFO) through an interagency agreement. On these 21 allotments, the RPFO only administers the grazing; the FFO manages all other uses on these allotments.

Alternative B would be located entirely within the boundaries of the Escavada AMP (6014) grazing allotment.

Alternative C would also be located within the Kimbeto Community allotment, with the Lybrook E15-2208 well pad and access road ROWs located within the Kimbeto Community (6013) grazing allotment. Table 3-14 lists details of these allotments.

Table 3-14. Details of the grazing allotments in the analysis area

Allotment Number	Livestock Number	Livestock Type	Period Begin Date	Period End Date	AUM
6013	324	Cattle	03/01	02/28	2,931
	15	Horse	08/01	10/31	162
	1,554	Sheep	03/01	02/28	3,220
6014	300	Cattle	03/01	02/28	2,880
	4	Horse	03/01	02/28	38

AUM = Animal Unit Month

3.11.2 Impacts from Alternative B: Proposed Action

Direct and Indirect Impacts

Surface disturbance associated with construction of the proposed action would remove approximately 54.2 acres of disturbed and undisturbed vegetation, resulting in a reduction in forage and a change to the vegetative species composition. Impacts to grazing resources would occur from the direct short-term loss of about 3.4 AUMs in the Escavada AMP allotment, at an estimated 20 acres per AUM. There would be a long-term loss of approximately 0.8 AUM in the Escavada AMP allotment, based on 20 acres per AUM. Reclaimed areas would be expected to re-vegetate within 1 to 2 years following reclamation. Reseeding of disturbed areas with the approved seed mix that is composed of grasses and palatable shrubs may result in an increase in available forage within the affected allotments. This increase is not expected to be measurable.

Cattle and horses may occur in the proposed analysis area, depending on the time of year. Livestock could also become trapped in the open trench and long sections of the open trench could present barriers to livestock movement. There would be a potential for livestock collisions with equipment and vehicles working in the area. However, livestock would be expected to avoid the area due to increased noise and activity. Gaps would be made as needed in topsoil or subsoil stockpiles to allow for livestock crossing. Pipeline trenches would be inspected for livestock prior to laying pipe and back filling; trenches would not be left open for more than 24 hours.

Livestock could come into contact with chemicals or fluids stored on-site. Use of a closed-loop system would minimize potential impacts to livestock from exposure to chemicals or fluids during drilling and completion. Any spills would be promptly cleaned up, and Encana maintains an emergency response plan. All chemicals or fluids stored on-site would be properly contained and would have secondary containment.

Cumulative Impacts

The cumulative impacts analysis area for impacts to grazing from the proposed action is the Escavada AMP grazing allotment. An estimated 102 acres of short-term disturbance has occurred within the allotment from the construction of 28 well pads. Long term disturbance in the totals 21 acres. The proposed action would contribute approximately 14.5 acres of long-term disturbance in the allotment. Other reasonably foreseeable activities within the allotment that would impact forage resources include off-highway vehicle traffic, vegetation treatments, and grazing. When added to past, present, and reasonable foreseeable activities within the grazing allotments, the proposed action would not result in measurable changes to the allotment's carrying capacity or to available AUMs.

3.11.3 Impacts from Alternative C

Direct and Indirect Impacts

Surface disturbance associated with construction of the proposed action would remove approximately 53.7 acres of disturbed and undisturbed vegetation, resulting in a reduction in forage and a change to the vegetative species composition. Short-term loss of forage would occur on 47.1 acres of the Escavada AMP allotment and 6.6 acres of the Kimbeto Community allotment resulting in impacts to approximately 2.7 AUMs. Approximately 16.5 acres in the Escavada AMP and 3.2 acres of the Kimbeto Community allotment would be converted to industrial use resulting in long-term loss of approximately 1 AUM. As with Alternative B, reseeding of disturbed areas with an approved seed mix composed of grasses and palatable shrubs may result in an increase in available forage within the affected allotments. This increase is not expected to be measurable.

Cumulative Impacts

The cumulative impacts analysis area for impacts to grazing from the Alternative C is the Escavada AMP and the Kimbeto grazing allotment. An estimated 102 acres of short-term disturbance has occurred within the Escavada AMP allotment from the construction of 28 well pads. Long-term disturbance in the Escavada AMP allotment totals 21 acres. In the Kimbeto allotment, there are 57 well pads that have resulted in 206 acres of short-term disturbance and 43 acres of long-term disturbance after reclamation. Alternative C would contribute approximately 13.4 acres of long-term disturbance in the two allotments. When added to past, present, and reasonable foreseeable activities within the grazing allotments, Alternative C would not result in measurable changes to the allotments' carrying capacity or to available AUMs.

4. SUPPORTING INFORMATION

4.1 Tribes, Individuals, Organizations, or Agencies Consulted

Table 4-1 contains a list of tribes, individuals, organizations, and agencies invited to attend the onsite for the project.

Table 4-1. Tribes, individuals, organizations, and agencies invited to the onsite

Name	Tribe, Organization, or Agency	Attended Onsite
Craig Spradley	BLM grazing allottee	Yes

The BLM fulfills its responsibilities under the NHPA through a number of agreements. The National Programmatic Agreement (NPA; 2012) between the BLM, Advisory Council on Historic Preservation (ACHP), and the National Council of State Historic Preservation Officers allows the agency to fulfill its NHPA responsibilities according to the provisions of the NPA in lieu of 36 CFR 800.3 through 800.7 regulations. The NPA, which applies to all BLM activities below specified thresholds, provides among other things, regulatory relief in many instances from the requirement for case-by-case review by State Historic Preservation Officers (SHPOs) and the ACHP, in exchange for managers' maintenance of appropriate staff capability and observance of internal BLM standards as set out in the 8100 Manual series.

The New Mexico BLM has a two-party protocol with the New Mexico SHPO (2014) specifically encouraged by the NPA. This protocol details how the New Mexico BLM and SHPO will regulate their relationship and consult. Specifically, this document outlines among other things, how and when consultation will be conducted between the BLM, SHPO, Tribes, and the public. The protocol also outlines when case-by-case SHPO consultation is or is not required for specific undertakings and the procedures for evaluating the effects of common types of undertakings and resolving adverse effects to historic properties. These common types of undertakings regularly include the common actions undertaken in the BLM/FFO.

The following individuals were consulted during the preparation of this EA.

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4.2 List of Preparers

This EA was prepared by Ecosphere in conformance with the standards of, and under the direction of, the BLM/FFO.

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4.3 References

Allen, D., A. Pacsi, D. Sullivan, D. Araiza, M. Harrison, and K. Keen. 2014a. Methane Emissions from Process Equipment at Natural Gas Production Sites in the United States: Pneumatic Controllers. *Environmental Science and Technology*, es5040156.

Allen, D., D. Sullivan, D. Araiza, A. Pacsi, M. Harrison, and K. Keen. (2014b). Methane Emissions from Process Equipment at Natural Gas Production Sites in the United States: Liquid Unloadings. *Environmental Science and Technology*, es504015.

Brugge, D. M. 1993. An Investigation of AIRFA Concerns Relating to the Fruitland Coal Gas Development Area. Office of Contract Archaeology, University of New Mexico. Ms. on file, Bureau of Land Management, Farmington, New Mexico.

Dick-Peddie, W. A. 1993. New Mexico Vegetation: Past, Present, and Future. University of New Mexico Press. Albuquerque, New Mexico.

Engler, T. W., S. Kelley, and M. Cather. 2014. Reasonable Foreseeable Development (RFD) for Northern New Mexico Final Report. Prepared for the Bureau of Land Management Farmington Field Office by New Mexico Institute of Mining and Technology. Socorro, New Mexico.

Griffith, G. E., J. M. Omernik, M. M. McGraw, G. Z. Jacobi, C. M. Canavan, T. S. Schrader, D. Mercer, R. Hill, and B. C. Moran. 2006. Ecoregions of New Mexico (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,400,000).

Freimund, W. and D. Dalenberg. Chaco Culture National Historical Park: 2009 Visitor Survey. The University of Montana. January 1, 2010.

Hebblewhite, M. 2011. Effect of Energy Development on Ungulates in Energy Development, editor David E. Naugle. Island Press, Washington, DC, USA.

Howarth, R., R. Santoro, and A. Ingraffea. 2011. Methane and the greenhouse-gas footprint of natural gas from shale formations. Climate Change, 679-690.

Intergovernmental Panel on Climate Change. (2013). *Climate Change 2013: The Physical Science Basis.* Cambridge: Cambridge University Press.

Kelly, K., R. Martin, R. Begay, T. Neff, and C. Werito. 2006. "We Will Help You With What We Know": Diné Traditional Cultural Places In Dinétah. Museum of Northern Arizona Environmental Solutions, Inc., Flagstaff. Ms. on file, Bureau of Land Management, Farmington, New Mexico.

Kort, E., C. Frankenberg, K. Costigan, R. Lindenmaier, M. Dubey, and D Wunch. 2014. Four Corners: The largest US methane anomaly viewed from space. Geophysical Research Letters, 6898-6903.

McLemore, V. T., R. F. Broadhead, G. Roybal, W. L. Chenowith, J. M. Barker, P. Copeland, M. R. Bowie, K. Cook, J. S. Hingetgen, K. Klein, and K. B. Brown. 1986. A Preliminary Mineral-Resources Potential of Western Rio Arriba County, Northwestern New Mexico. New Mexico Bureau of Mines and Mineral Resources Open-File Report 233.

New Mexico Bureau of Geology and Mineral Resources. 2003. Geologic Map of New Mexico, 1:500,000: New Mexico Bureau of Geology and Mineral Resources.

New Mexico Environment Department (NMED). 2010. Inventory of New Mexico Greenhouse Gas Emissions: 2000-2007. Available online at: http://www.nmenv.state.nm.us/cc/index.html.

New Mexico Department of Transportation. AADT data. 2014 Available online at: http://dot.state.nm.us/content/dam/nmdot/Data_Management/NM_AADT_Listing.pdf.

New Mexico Partners in Flight (NMPIF). 2007. New Mexico Bird Conservation Plan Version 2.1. C. Rustay and S. Norris, compilers. Albuquerque, New Mexico.

Schneising, O., J. Burrows, R. Dickerson, M. Buchwitz, M. Reuter, and H. Bovensmann. 2014. Remote sensing of fugitive methane emissions from oil and gas production in North American tight geologic formations. Earth's Future, 548-558.

TRIP. 2013. New Mexico Transportation by the Numbers: Meeting the State's Need for Safe and Efficient Mobility. Available online at: http://www.tripnet.org/docs/NM_TRIP_by_the_Numbers_Report_Feb_2013.pdf.

U.S. Department of Agriculture, Soil Conservation Service (USDA/SCS). 1980. Soil Survey of San Juan County Area, New Mexico, Parts of Los Alamos, Sandoval, and Rio Arriba Counties. Prepared by the United States Department of Agriculture, National Resources Conservation Service in cooperation with the United States Department of the Interior, Bureau of Land Management and Bureau of Indian Affairs; and the New Mexico Agricultural Experiment Station.

U.S. Department of the Interior, Bureau of Land Management (USDI/BLM). 2002. Biological Assessment: Impacts to threatened and endangered species related to the resource management plan. U.S. Department of the Interior, Bureau of Land Management, Farmington Field Office, Farmington, New Mexico.

USDI/BLM. 2003a. Farmington proposed resource management plan and final environmental impact statement. U.S. Department of the Interior, Bureau of Land Management, Farmington Field Office, Farmington, New Mexico.

USDI/BLM. 2003b. Farmington resource management plan record of decision. U.S. Department of the Interior, Bureau of Land Management, Farmington Field Office, Farmington, New Mexico. U.S.

USDI/BLM. 2005. BLM Manual Supplement H-8100-1. Procedures for Performing Cultural Resources Fieldwork on Public Lands in the Area of New Mexico BLM Responsibilities. New Mexico, Oklahoma, and Texas.

USDI/BLM. 2008. NEPA Handbook H 1790 1 [BLM 1/30/2008]. Washington, D.C.

USDI/BLM. 2010. Instruction Memorandum No. NM-F00-2010-001. Migratory Bird Treaty Act—BLM/FFO Interim Management Policy. Bureau of Land Management, Farmington Field Office, Farmington, New Mexico.

USDI/BLM. 2014. Air Resources Technical Report for Oil and Gas Development. New Mexico, Oklahoma, Texas, and Kansas. Bureau of Land Management, New Mexico State office. Santa Fe, New Mexico.

U.S. Department of the Interior and United States Department of Agriculture (USDI/USDA). 2007. Surface and Operating Standards and Guidelines for Oil and Gas Exploration and Development. BLM/WO/ST-06/021+0371/REV 07. Denver, Colorado. 84 pp.

U.S. Environmental Protection Agency (USEPA). 2004. Evaluation of Impacts to Underground Sources of Drinking Water by Hydraulic Fracturing of Coalbed Methane Reserves. Office of Ground Water and Drinking Water (4606M). EPA 816-R-04-003.

USEPA. 2012. 2005 National-Scale Air Toxics Assessment. Retrieved February 27, 2014, from U.S. Environmental Protection Agency. Available at http://www.epa.gov/ttn/atw/nata2005/.

USEPA. 2013a. The Green Book Nonattainment Areas for Criteria Pollutants. Retrieved February 25, 2014, from U.S. Environmental Protection Agency. Available at http://www.epa.gov/airquality/greenbook/.

USEPA. 2013b. Air Quality Index Report. Accessed March 12, 2014, from U.S. Environmental Protection Agency. Available at http://www.epa.gov/airdata/ad_rep_aqi.html.

USEPA. 2014. Air Trends: Design Values. Accessed February 25, 2014, from U.S. Environmental Protection Agency. Available at http://www.epa.gov/airtrends/values.html.

U.S. Fish and Wildlife Service (USFWS). 2008. Birds of Conservation Concern 2008. United States Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, Virginia. 85 pp. [Online version available at http://www.fws.gov/migratorybirds/].

Van Valkenburgh, Richard F. Van. 1941. Diné Bikeyah. Department of the Interior, Office of Indian Affairs, Navajo Services, Window Rock. Ms. on file, Bureau of Land Management, Farmington, New Mexico.

Van Valkenburgh, R. F. 1974. Navajo Sacred Places, ed. Clyde Kluckhohn. In Navajo Indians III, pp. 9-199. Garland Publishing. New York.

Williamson, T. E. and S. G. Lucas. 1992. Stratigraphy and Mammalian Biostratigraphy of the Paleocene Nacimiento Formation, Southern San Juan Basin, New Mexico. New Mexico Geological Society Guidebook, 43rd Field Conference, San Juan Basin IV, 1992.

Appendix A – Maps and Photographs

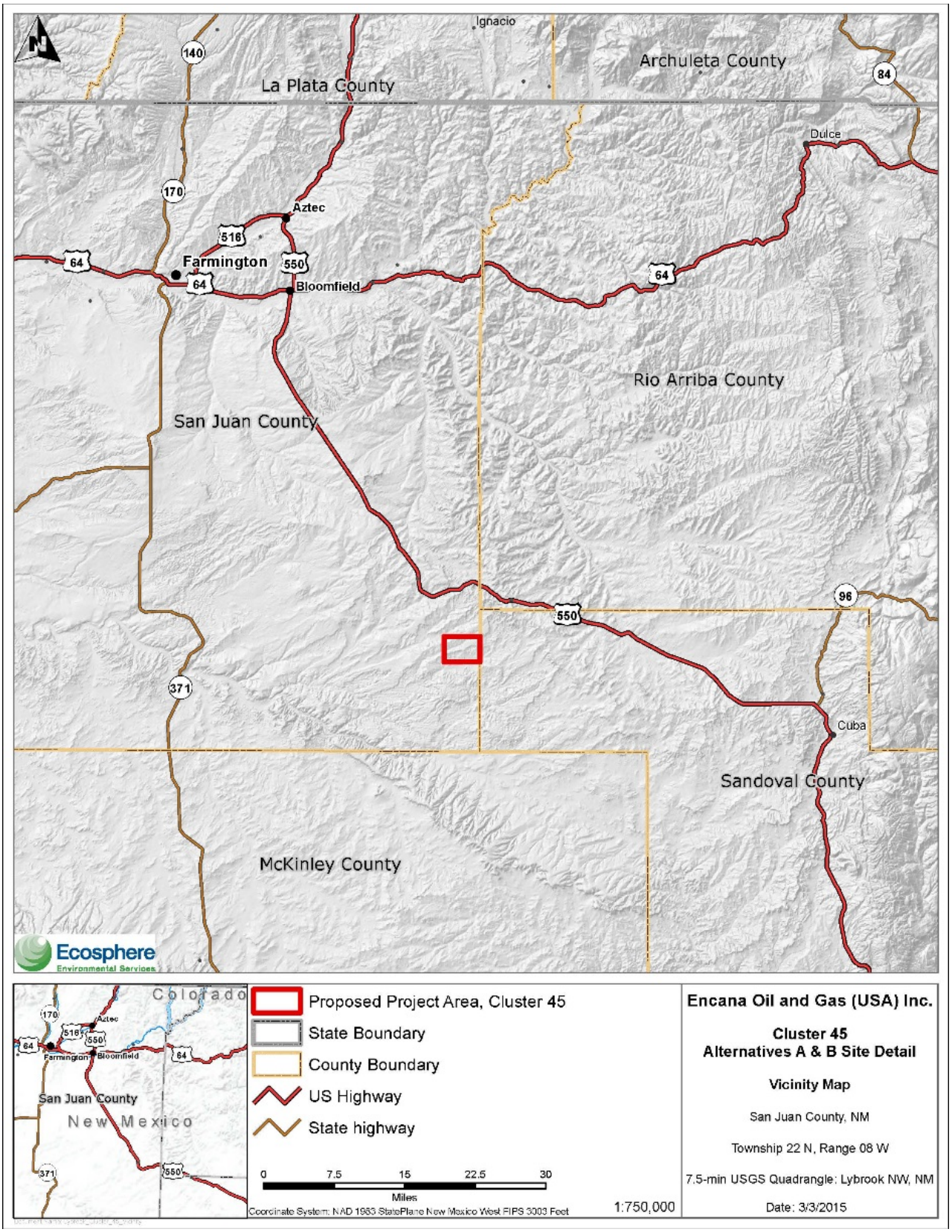

Figure 1. Proposed Cluster 45 and vicinity

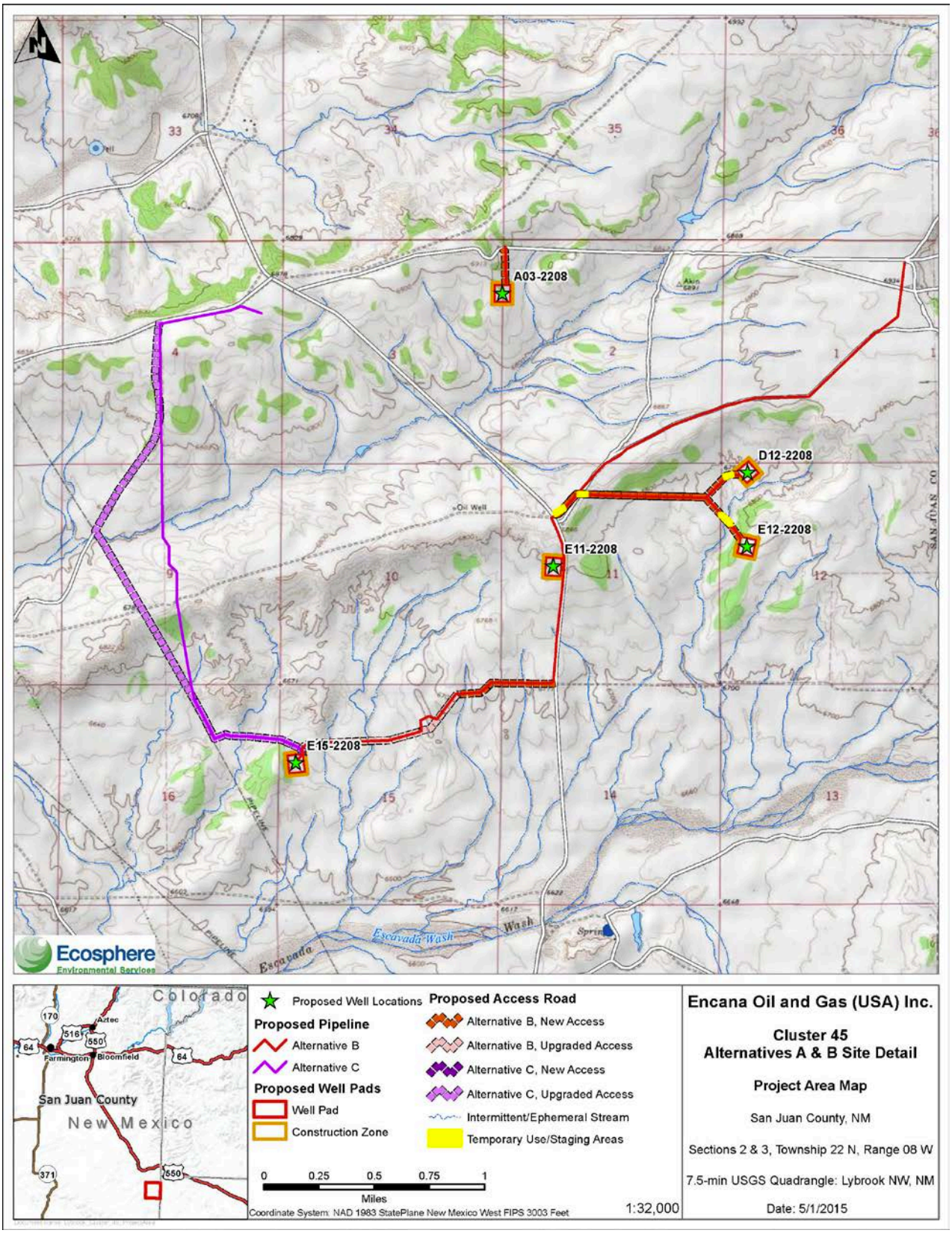

Figure 2. Proposed Cluster 45 Project Area

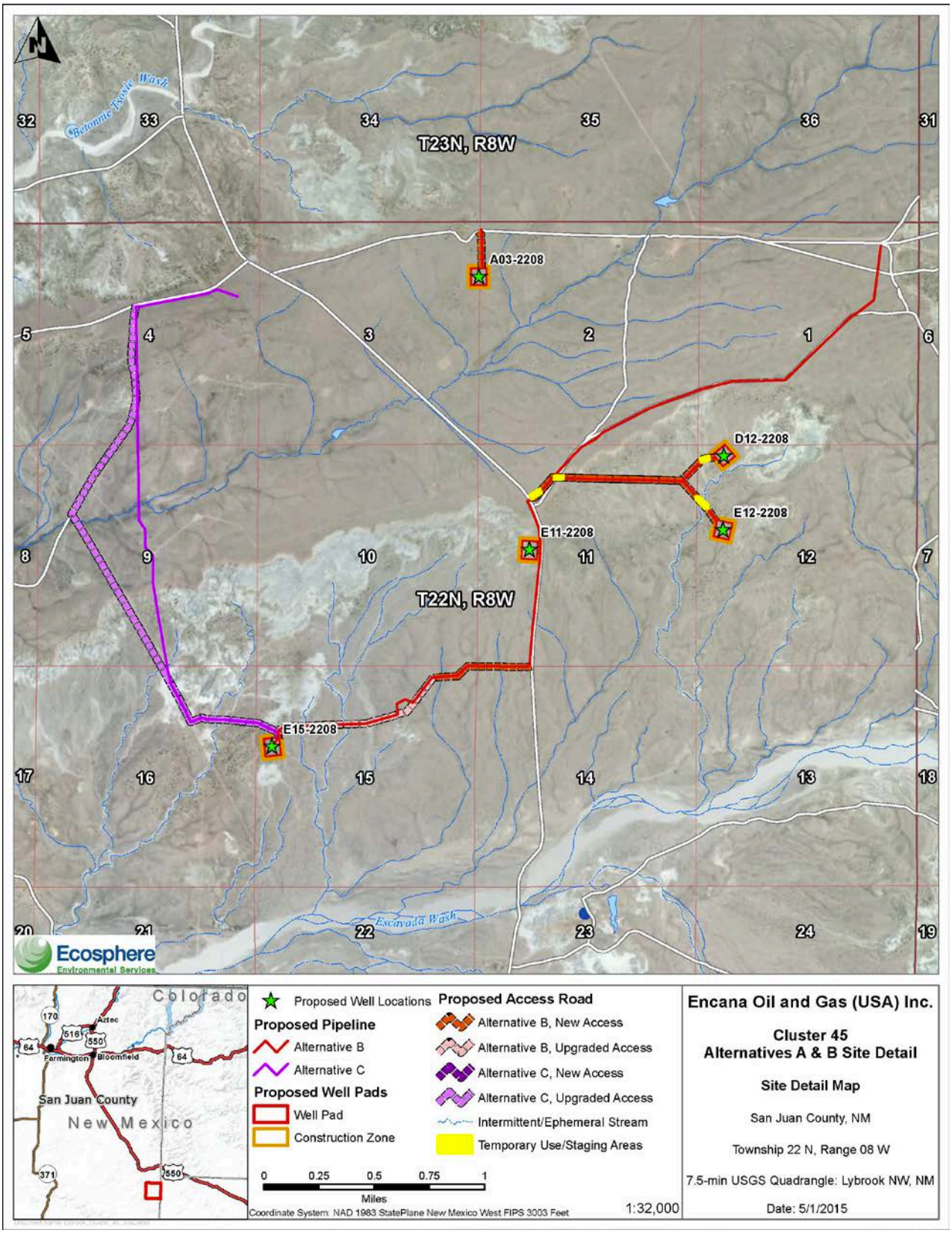

Figure 3. Proposed Cluster 45 Site Detail Map

Photograph 1. Lybrook A03-2208 from the center stake looking north

Photograph 2. Lybrook A03-2208 from beginning of the access road

Photograph 3. Lybrook D12-2208 from center stake looking north

Photograph 4. Lybrook D12-2208 from beginning of the access road

Photograph 5. Lybrook E11-2208 from center stake looking north

Photograph 6. Lybrook E11-2208 from beginning of the access road

Photograph 7. Lybrook E12-2208 from center stake looking north

Photograph 8. Lybrook E12-2208 from beginning of the access road

Photograph 9. Lybrook E15-2208 from center stake looking north

Photograph 10. Lybrook E15-2208 from beginning of the access road

Photograph 11. Lybrook E15-2208 alternative from center stake looking north

Photograph 12. Lybrook E15-2208 alternative from beginning of the access road

Appendix B – Applications for Permit to Drill and Right-of-Way Grants

Appendix C – Conditions of Approval and Pipeline Stipulations

Appendix D – Biological Survey Reports